A MANUAL FOR HANDLING BEARS FOR MANAGERS AND RESEARCHERS

BY

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(Edited by Timothy J. Thier)

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This Publication was written by James J. Jonkel (Interagency Grizzly Bear Study) and reviewed and edited by Tim Thier (U.S. Fish and Wildlife Service). Several words of caution for this publication are appropriate. This manual was primarily written as a reference for game wardens, park rangers, biologists, and others who find themselves in the position of capturing and handling bears. The techniques, methods, and drugs discussed within will undoubtedly advance and change over time. When specific problems arise, advice beyond the manual is recommended. Because of the unique nature of each capture and handling situation, the author and agencies involved in the printing of this manual refuse to assume any legal responsibilities that may result from the capturing and handling of bears by others.

This manual is dedicated to the memory of Dan Palmisciano, Kirk Inberg, Kevin Roy, John Bevins, Wilf Etherington, and to others who have died while actively involved in bear research and management.

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ACKNOWLEDGEMENTS

At this time I would like to thank Drs. Charles Jonkel, Richard Knight, and the many other individuals and agencies who have made this manual possible. Special thanks to Tim Thier who reviewed and edited the manuscript. I would also like to thank Dr. Chris Servheen, Prof. Sharon Barrett, and Joan Jonkel. This publication incorporates the knowledge of many individuals involved in various aspects of bear research and management such as Mark Haroldson, Keith Aune, Bart Schleyer, Harry Carriles, Carrie Hunt, Dan Carney, John Murnane, and many others. A special thanks is also extended to the veterinarians Marian Van der Schraaf, Rick Levesque, Connie Orr, Joseph Thompson, and Mark Johnson. I am grateful to all of these individuals.

INTRODUCTION

Why the Manual was Written

The step-by-step procedures, precautions, and techniques in this manual are assembled from both the positive experiences and mistakes of wildlife researchers, managers, and veterinarians who have dealt extensively with bears. The main goal of this manual is to assist and educate future bear handlers and to help reduce the number of bear and human injuries and deaths. This manual is not designed to replace hands-on experience. **The only way to learn how to capture and handle bears properly is through an apprenticeship with experienced professionals!**

Every year bears are captured, drugged, handled, and relocated by park rangers, game wardens, federal trappers, and biologists. Some of these people do not have the confidence or expertise to do their job with minimal risk to the animal or crew. Human error has been a factor in bear mortalities and injuries. Since 1959, for example, 42 grizzly bear deaths in the Yellowstone Ecosystem have been documented as trapping and drugging-related casualties (Craighead et al. 1988). Some errors are repeated almost annually. This manual was written to provide individuals in bear management or research with a clear and concise field reference that has an emphasis on proper techniques.

Hard and fast rules are impossible, and every person will do things differently. The techniques discussed in this manual are offered only as a reference and an aid to understanding the problems and dangers involved in bear research and management. There are other trapping and handling methods and procedures used by bear handlers that are safe and reliable. If you find a safer, more efficient technique, by all means use it.

The safety measures emphasized in this manual are primarily directed towards individuals handling grizzly bears. Although safety should never be taken casually, black bears generally pose less of a risk to the handlers or public. As a result, some of the safety measures recommended in this manual can be relaxed somewhat when dealing with black bears. The actual handling techniques for both black bears and grizzlies, however, are very similar.

Safety Precautions

There are three primary rules to follow when working with bears, especially grizzly bears:

1) **Never make yourself or anyone else available to a bear.** The bear should always be securely captured or drugged before you approach. If there is absolutely no way to physically restrain a bear before drugging, you should be in a vehicle or safe location with a planned escape route.

2) **Approach every trapping, drugging, and handling situation as if you will not have the protection of a firearm.** Too many bear

handlers depend on firearms to get them out of trouble.

3) **Before making any decisions or setting any trap, look at all the possible outcomes.** Is there an opportunity for something to go wrong? Can you see from a safe distance whether or not the site has been disturbed? Could a citizen stumble onto the trap site when a cub is captured? Could the bear, when recovering from the drug, stumble downhill and fall over a cliff? Could an elk or moose get captured in this snare? Is there any possibility that this female bear being relocated has more than one cub? Could this bear being released from a culvert trap attack me? Ask yourself these kinds of questions, and do some preventive planning.

Ethics and Professionalism

The Kuuvangmiit Indians of coastal Alaska believe that humility is the key to peaceful encounters with bears. Elders instruct hunters not to brag about how many bears they have killed, not to behave arrogantly, and not to talk about bears in a threatening manner. Some of the natives disapprove of biological research requiring the handling of bears. For example, some Inupiaq hunters worry about the safety of "... biologists engaging in such research, fearing that bad things may happen to them for being - in the villagers' view - disrespectful to bears" (Georgette 1989).

Albert Schweitzer's book "Reverence For Life" states that scientists "... must ask themselves whether there is a real necessity for imposing such a sacrifice upon a living creature." The intent of most bear research today is to improve population numbers and to reduce conflicts with people. In order to better understand and study bears, usually radio telemetry is required. This relies on the ability to capture and handle bears with a minimum of trauma. Each researcher must weigh the final outcome and potential benefits of his or her study and determine if capturing and handling is really necessary.

Ideally, bear managers must first know when not to trap and handle, when and how to trap and handle, and finally when to stop trapping and handling. Many managers and private citizens believe bears avoid areas inhabited by humans, and that certain "bad bears" move into the area to cause trouble. Bears do not usually leave when people appear. They either stay and learn to live with people or they get killed. During exceptionally bad food years bears may become more visible and are more easily lured into conflicts with humans, requiring some type of management action.

Often in management situations where grizzly bears are involved, the bear "problem" is grossly exaggerated. For example, in 1986 on Montana's Gallatin National Forest, it was rumored that an enraged, wounded grizzly bear with cubs was lurking on the fringes of a hunting camp. A member of the Interagency Grizzly Bear Study Team (IGBST) was sent in by helicopter to check out the situation, only to discover that "no, a bear wasn't in camp, but one did walk by camp about a week ago." In another situation on Montana's Flathead National Forest in the spring of 1989, a local

radio station reported that a grizzly bear had just killed and partially eaten a mushroom picker. Approximately 60 men with rifles swarmed to the area. The report turned out to be totally false, and information on who first reported the incident was vague.

Before heading out into the field, gather information to determine if a trapping or management effort is really necessary. The first and most important thing to accomplish before setting out is to touch base with the landowners and local state and federal officials. Interview the local game warden, Forest Service district ranger, biologist, and any other pertinent people involved and find out what the situation is. Every effort should be made to create a smooth working relationship and to coordinate activities.

In situations involving management, trapping actions will depend on the situation and the location. Once you have gathered your necessary equipment, go to the site and attempt to solve the situation by removing, or making unavailable, whatever attracted the bear to the site in the first place. Only as a last resort should the bear or bears be trapped, handled and relocated. There are a number of good reasons why bears shouldn't be captured and moved. First, you endanger the life of the bear and people by making contact. Second, by capturing and marking a bear because of a possible bear/human conflict, you are in essence giving the bear a "criminal" record. Often bears are trapped and relocated repeatedly until the decision is made to destroy them. Many times bears are categorized as "problems" instead of the source that was luring them into the vicinity in the first place. Finally, when you trap a bear and relocate it to another region, you not only avoid the real problem, you also decrease the bear's chances of survival.

Occasionally, the only option available is to move the bear to an area uninhabited by people, which in the lower 48 states is increasingly difficult to find. Older bears, no matter how far they are moved, often work their way back. Younger bears are more likely to establish new home ranges. Generally, grizzly bears should be moved at least 70 miles and black bears 40 miles from where they were captured (Thier pers. comm.).

Some bears that have been poorly managed will continue to cause problems and will have to be destroyed. The decision to kill a bear should be a last resort. Habituated behavior in bears is usually an indication of poor people management; "problem bears aren't born, they're made". Preventative planning is the key to managing bears.

Human safety should always come first, but bear handlers always have the obligation to minimize pain and suffering to the animal. Researchers and managers working on bears, especially with Threatened grizzly populations, must do everything possible to avoid all unnecessary deaths and injuries. Because of the national attention focused on the grizzly, an accidental bear or human death or injury during a trapping operation could have drastic repercussions.

The legalities encompassing bear research and management are vague. Government and state employees have the obligation to protect people. The majority of the public assumes that they will

be warned if dangerous animals are in the area, and that efforts will be made to capture and move or dispose of any animals posing a threat.

It is difficult to define the mandatory duty of a bear researcher or manager. Whenever in doubt, the agency's attorney should be consulted. It all comes down to an issue of "adequate warning." When a researcher or manager can prevent an injury by informing the public, they have the duty to do so. If a collared bear is moving through a campground, for example, the public should be informed of the danger.

Future court suits involving bears, the public, bear managers, and researchers are inevitable. Therefore, it is important to document every aspect of every management situation and trapping episode. Bear researchers and managers must make careful decisions and always warn the public when a trap has been placed in the vicinity or when there is a potential for a confrontation. Education and communication are the best tools when working with the media and the public.

CAPTURING BEARS

Understanding the Animal

Bears are extremely intelligent animals. They investigate and communicate, have intense family and social relationships, show insight, reason, and exhibit thought processes humans can recognize (Herrero 1985). Bears can memorize terrain and cover, and they can learn how to take advantage of humans. As with other animals, the primary objectives of a bear are to stay alive, eat, and reproduce. Bears are most intent on one thing - searching out and exploiting new sources of food. By keeping this in mind and understanding other aspects of bear behavior, one can expect to capture bears. Bears do learn from their experiences, so it is important to set traps properly.

The best way to determine the sex, size, and species of bear you will be dealing with in management situations is to look for sign. If you know what kind of bears you might be dealing with before you set traps, the better your chances of being prepared. If there is a family group of bears in the vicinity, for example, you can set traps in such a way that you lower the chances of catching cubs or increase the odds of catching the whole family. In the case of livestock depredation, government trappers from APHIS (Animal and Plant Health Inspection Service) may be able to help determine if the predator was a grizzly or a black bear.

Grizzly bears have long, wide claws that are very similar in size to human fingers that are used primarily for digging. The scratch marks made by grizzlies while digging, tearing up logs, and scratching trees are wide and blunt, like finger tips. The underside of grizzly bear claws have grooves that may leave distinctive imprints in the soil. Mud collected in these grooves occasionally falls out and can be found on hard surfaces or in the grass. Grizzly bear claws will wear down when the animal is living and feeding in rocky terrain and become substantially shorter. Black bears have shorter, sharper, and more curved claws that are more adapted for climbing. The scratch marks are narrower and more pointed.

Clear front foot tracks can be difficult to find. Bears often overstep the front foot with the hind foot. A track from a grizzly bear's front foot is more square in appearance than a black bear track. The claw tips will make a bunched pattern about 2 inches in front of the middle toes. The claw marks on black bear tracks are more directly in front of each toe about 1 1/4 inches. By laying a straight edge along the top of the main pad where the inside toes connect onto the front foot, one can often determine the species of bear (Fig. 1). If the small outer toe is dissected by the straight edge below the toe's middle point, it means the foot is more square and the track is most likely a grizzly's (Palmisciano 1986). In wet soil a grizzly track may appear more rounded, like a black bear's, because of the way the bear rolls its feet when walking. In these

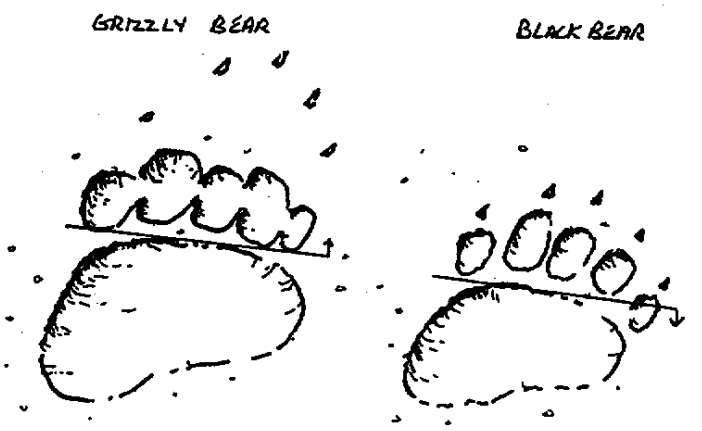

Figure 1. Differentiating the front track of a grizzly bear vs. a black bear. The claw marks of a grizzly are uaually about 2" from the toes compared to 1 1/4" for a black bear. Also, if more than 1/2 of the little toe falls below a straight edge laid across the front of the main pad, it is most likely a black bear (drawing by N. Wiegert).

instances it is easier to mistake a grizzly track for a black bear track.

Hairs found clinging to barbed wire, brush, and debris in day beds or hairs found inside bear scats from grooming, can sometimes be used to determine the species. If the bear hair has a light tip, it is probably a grizzly. Do not confuse the hair root for a silver tip. If possible, observe several long guard hairs before trying to make a decision. Hair from unknown species can be collected and sent to a lab for identification (Picton and Knight 1980).

Grizzlies are more adept at digging for food and caching animal carcasses than black bears. If you find a series of excavations for plant roots and tubers or rodents, then you are probably dealing with a grizzly. Look for claw marks, tracks, and hair in and around the digging.

It is very difficult to tell the sex of the bear unless it is obvious from the tracks that it is a female with young. Bear track sizes vary considerably from region to region. In the Rocky Mountains, black bear cubs have front pad widths ranging from 2 1/2 to 2 7/8 inches, adult females 3 1/2 to 4 1/2 inches, and adult males 4 1/2 to 5 1/2 inches or more (LeCount 1986). Grizzly bears are similar, but average about an inch larger. If there is tracking

snow, look for urinations. Females usually squat to urinate, while males tend to walk and dribble while urinating. If you find a bedding site, look for urine secretions and the bed size to determine the sex and body size of the bear. If you find scats and tracks of various sizes indicating a family group, then you should set several traps instead of one.

Notes on Culvert Traps

Culvert traps allow managers and researchers to capture a bear with the options of drugging the animal for handling or just releasing it. Once a bear is captured in a culvert trap, it can be held in captivity, or it can be moved by a vehicle or helicopter to another region where the animal can be released. Culvert traps are easy to set and, if properly designed, are usually safer for the bear and the handler than snares. Bears can be approached safely with limited stress to the animal. Only wary bears will refuse to enter a culvert trap.

The disadvantages to culvert traps are that they are heavy, attract attention, are hard to maneuver, and are primarily limited to areas accessed by roads. Bears can also damage their teeth and jaws in poorly built culvert traps, and there is always a chance that a bear could be injured or killed when the door drops, if the trap's design is poor. Also, culvert traps have poor ventilation and will heat up in the sun.

There are a wide variety of homemade and commercially sold culvert trap designs (Fig. 2 & 3). Culvert traps have been made out of water culverts, military missile carriers, and lightweight aluminum. There are culvert traps with sliding doors, swinging doors, and separation chambers. Some traps are made to fit in the back of pickup trucks or trailers, and others have built-in axles so they can be towed behind a vehicle. Some trap doors can be opened electronically. Other traps are so poorly designed that it is next to impossible to release a bear without making the handlers vulnerable to an attack. Many traps are built in such a way that they promote injuries to bears. The best trap styles today are the lightweight aluminum traps built for Yellowstone National Park, the U.S. Fish and Wildlife Service, and Montana Department of Fish, Wildlife, and Parks. This design is built to minimize tooth damage and is easily handled (see Appendix VII).

Before using any unfamiliar culvert trap, check it over carefully for design flaws or damage. The trap must be able to restrain a bear without causing injury if the animal attempts to escape. First, crawl into the trap with a bear skull and attempt to imitate a bear biting the mesh, the trap doors, drainage holes, and any other openings. If you can get a canine hooked in any of the holes, the trap should be redesigned or not used. The worst kind of metal mesh is diamond shaped, in that it allows a bear to wedge its claws or teeth in the grooves. Next, reach around with your hands to see if a bear could grip onto the door frame, the mesh, or a

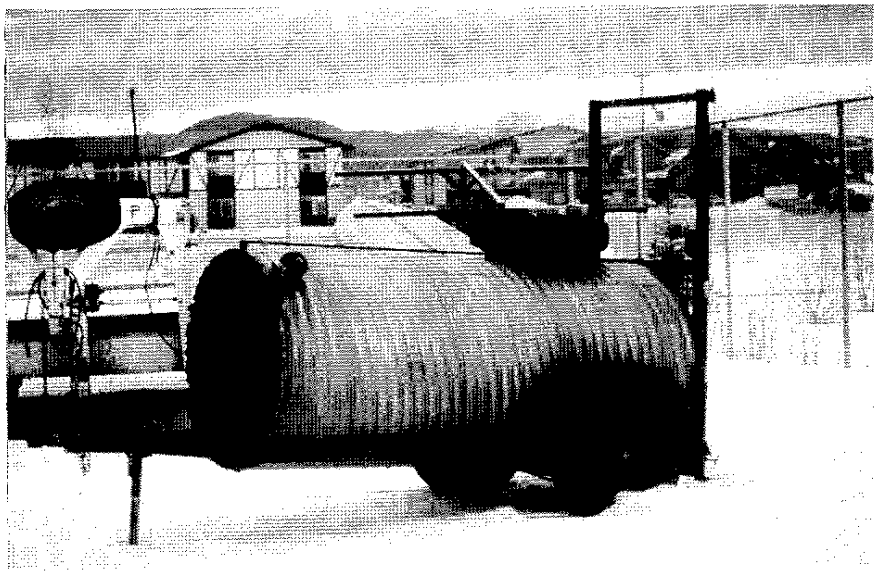

Figure 2. A typical home-made culvert trap. The mesh on this trap is quite large and could cause injury to a bear's teeth.

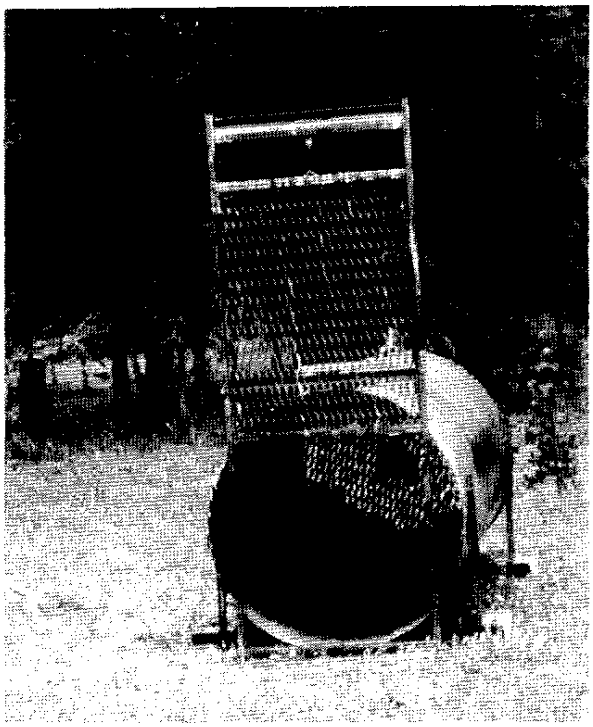

Figure 3. A culvert trap with diamond-shaped mesh. This kind of trap is dangerous to bears and should not be used. Bears will catch their claws in the grooves of the mesh and pull them off.

side door and cause damage to its paw or the trap. File away any sharp edges and weld plates over any edges that a bear could grab. Check the bottom of the trap's sliding door. If the edge is narrow and sharp, weld a plate or lip on the bottom. If the door is exceptionally heavy, rebuild a lighter door. Carefully check all the trap's welds inside and out. Look for rust damage on the walls and floor. Bears are amazingly strong and have escaped and broken out of culvert traps. If a bear discovers a weakness or a movement in the trap, it will work that site continuously in hopes of escape (Fig. 4).

The culvert trap should be at least 8 feet long so that a bear must enter all the way to reach the bait. This will decrease the chances of having a bear stretching with a paw to get at the bait. At the same time, a longer trap will allow two bears to enter the trap with less chance of having the door crash down on one bear's back. The trap should also be lightweight in case the bear and the trap need to be picked up and moved with a helicopter. Each trap should have sufficient ventilation and drainage holes and a trough for supplying the bear water.

When drugging a bear in a culvert trap, you want to be able to see it clearly. When the door is down, there should be enough light getting inside. If needed, drill a series of small holes in

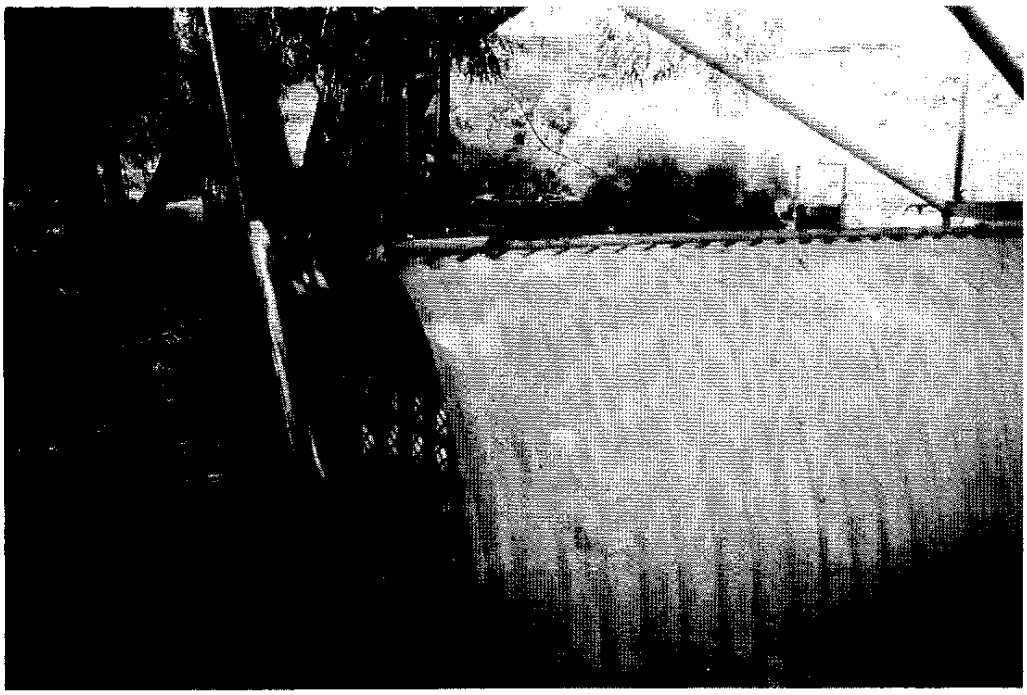

Figure 4. A bear-damaged culvert trap. The bear was able to escape after it broke the welds on the door's frame.

the roof of the trap to let in light. You should be able to get a blow gun, pistol, or jab stick through the mesh or bars at the ends of the trap. Only as a last resort should you have to open a side door to drug a bear in a culvert trap. The side doors should be smaller than a bear's head and the door should overlap the hole and lock securely.

Most importantly, every culvert trap door should be equipped with a sturdy locking device that will lock the door down or up. When releasing a bear, you want the door to lock in the "up" position when the door opens to a certain height. If possible, the door lock should be covered with a metal plate to prevent other bears from unlocking the door. Culvert traps should be maintained regularly and painted a light color to prevent heat absorption. Air scoops on the sides will help cool bears when transporting them on hot summer days. Steel traps should be painted regularly to prevent rust damage. Traps designed to be pulled behind a vehicle should be wired for lights, have a spare tire, a strong trailer hitch with a safety chain, and a jack mounted to the tongue to make hook-ups to a truck much easier. Always return culvert traps to camp or office when not in use, and lock the door down with a padlock to prevent unauthorized use.

Notes on Aldrich Foot Snares

Foot snares are more versatile than culvert traps and can be used in a variety of ways to catch bears. Snares are lightweight, inconspicuous, and fairly easy to set, rebuild, and maintain. Foot snares permit researchers and managers to work in the back country and front country with ease, allowing trappers to get the job done quickly and unobtrusively. Instead of luring bears in, a trapper can go directly to the bear's location away from people. With minimal effort, an area can be saturated with snares. Several snares can be routinely set at each site to limit the probability of catching only the cub and having an angry female guarding the trap. Great care should be taken not to set snares too close together. Bears captured within reach of each other will fight or become seriously tangled in the cable and injured.

It is usually easier to capture a bear that is guarding a trapped animal in a snare than with another culvert trap. When the bear moves off, snares can be set around the trapped animal. Also, snares can be fitted with devices that allow cubs and smaller bears to pull their paws out of the loop.

The biggest disadvantage of foot snares is that bears have to be drugged in order to be released. Also, a few bears have chewed their feet, broken bones, and escaped with snares still attached to their feet. If snares are not set properly, they are more apt to twist apart, catch a bear too high on the leg, or catch them by a toe. These situations are dangerous not only to the bear, but also to the handlers.

Snares and springs can be purchased through Margo Supply Ltd.,

(Calgary, Alberta) or the snares can be reconstructed from material purchased at a local hardware store. Snares can be rebuilt out of 1/4, 9/32, 5/16, and 3/8 inch galvanized steel aircraft cable (7 x 19 strand). Snare loops made out of 1/4 inch cable pull up tightly around the wrist and have a 7,000 pound test, but are more prone to fraying than the heavier cable. Heavier cable is stronger, but does not pull up as tightly or quickly, which allows some bears to escape. The size of the cable depends on your preference, but 1/4 inch is the most widely used (Fig. 5).

The cable used for snare loops should be cut into 53" lengths, and the cable for the snare's tail should be cut into 10-12 foot lengths using a cable cutter or cutting torch. The snare loop should have a diameter of at least 12 inches. The tail piece should be long enough to be wrapped two or three times around a smaller tree or once around a large tree. The ends of the cable should be soldered or epoxied to prevent untwisting if cut with a cable cutter. If the cable is brazed or welded, be careful not to overheat as it will cause the cable to become brittle. Check all cable ends that are to be used for loops to make sure they are small enough to fit through the holes in the angle iron.

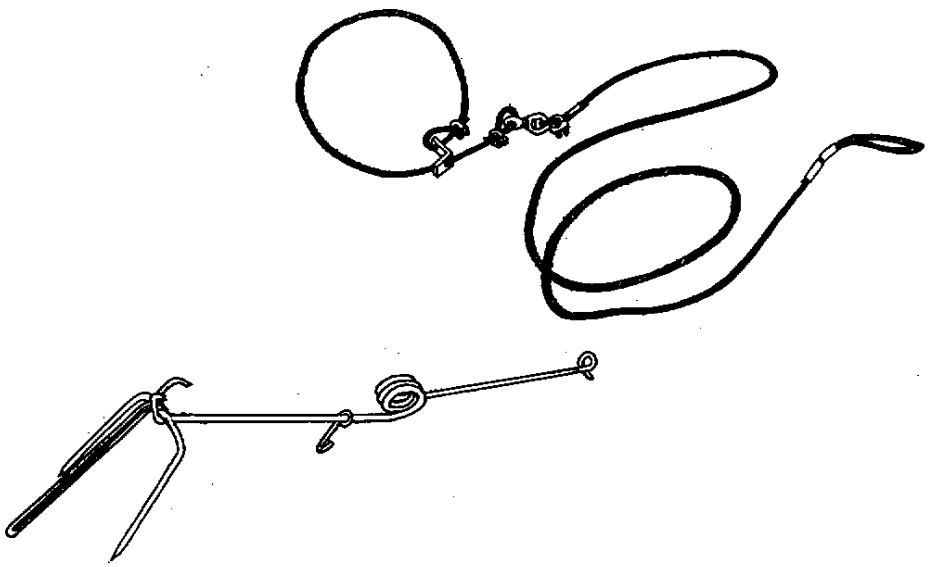

Figure 5. The Aldrich Foot Snare and Spring (drawing by N. Wiegert).

The snare can be reassembled with cable clamps and/or compression sleeves. Compression sleeves are easier to use and do not require maintenance, but they require heavy cable cutters and a large compression tool in the field. When bears become twisted in a snare, they may have to be cut out of a snare built completely with compression sleeves. If you are working in remote regions where the weight of equipment must be considered, snare loops should be built with cable clamps that can be built or taken apart with a socket wrench. Cable clamps should be secured with Lock Tight liquid and checked and replaced frequently as they will loosen and crack.

The loop is the most difficult portion of the snare to rebuild. First, throw the cable for the loop onto the ground and make note of the cable's form. Always rebuild into the natural flow of the cable, or the snare loop will not lie properly. Place an angle iron onto the loop and attach it with an appropriately sized cable clamp or compression sleeve. Make sure the cable is attached to the angle iron's larger hole. (The smaller hole is for the sliding portion of the cable; check for excessive wear.) The nuts and threaded stem of the cable clamps, and the dead end of the cable should be on the outside of the snare loop. Do not over-tighten the clamp's nuts as you may strip the threads or crack the clamp. If compression sleeves are used, file off the sharp edges on the inside of the loop. The angle iron, which acts as a sliding and locking device on the snare, can be cut into 3/4 inch widths from 1/4 inch thick angle iron and drilled with the appropriately sized holes for the cable. The sharp edges on the angle iron should be filed down to prevent injury.

If needed, devices can be placed on the snare to prevent the capture of smaller bears. Attach an appropriately sized piece of surgical tubing 6 to 8 inches long over the cable and down to where the angle iron is attached. Surgical tubing is the best "cub stop" because it still allows the loop to pull up tight when a medium-sized bear struggles to escape. If nothing else, electrician's tape can be wrapped around the cable and used as a "cub stopper." These devices can also be used to target larger bears (Fig. 6).

Next, bring the other end of the snare loop through the smaller hole in the angle iron. Test the action of the loop several times and, if needed, rebuild the loop. Attach the free end of the snare loop to a 1/2-inch oval-eye, forged steel swivel, which has a 3,600 pound test. Use either two cable clamps or a single compression sleeve. Make sure at least 1/2-inch of the dead end of the cable extends past the sleeve or clamp.

Examine the swivel for defects and to see if it rotates properly. The swivel is important in that in that it prevents the cable from twisting and breaking and the bear from injuring itself. Attach the tail of the snare to the other end of the swivel in the same way as the loop and make a loop at the end of the tail with two more clamps or a single sleeve. Johnson and Pelton (1980) added

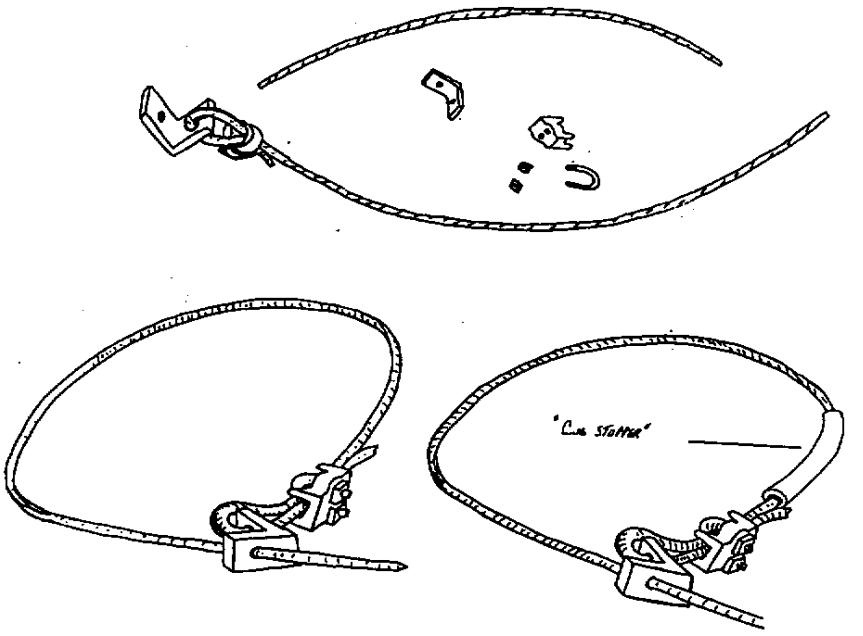

Figure 6. Rebuilding a snare loop (drawing by N. Wiegert).

Pelton (1980) added car hood springs to the tails of their snares to act as shock absorbers (Fig. 7).

When the rebuilt snare is finished, it should be coiled in such a way that the loop will keep its shape. Close the loop half way and lay several wraps of cable beside it and than weave the rest to the snare through and around the loop. If the snares and springs are exceptionally bright and shiny, they can be darkened by boiling them with pine needles, grass, or bark for half a day. If desired, paraffin wax can be added to the hot water. The paraffin will coat the snares and spring, reducing the smell of metal and lubricating the snare loop's sliding action. Snares can also be placed in a stagnant pond for several days to reduce human scent and discolor them.

The springs for Aldrich bear snares come in two sizes - one for black bears and the other for grizzly/polar bears. The black bear sized spring will not adequately handle cable any larger than 3/16 inch. Many people believe that size of cable is too small for black bears and should not be used. The smaller diameter results in considerably more injuries by digging into the bear's wrist and cutting off circulation. Also, there is a greater chance of the cable breaking, especially if a grizzly or another large animal such as a moose or elk is caught. The larger sized grizzly springs are actually superior when trapping black bears because of their faster action.

Most trappers believe that care should be taken to minimize human scent on snares, and that cotton or rubber gloves should always be worn. Others think that bears, unlike coyotes, have no

qualms about human scent or the smell of steel and take no precautions. When dealing with trap-wise bears, care regarding human scent is obviously warranted. Even though most bears are more concerned about getting the bait than avoiding human scent, precautions that limit human scent undoubtedly help maximize trapping success. Snares can be stored by hanging them outdoors, or by placing them in a wooden box with conifer boughs or strong smelling plants like sage or licorice root.

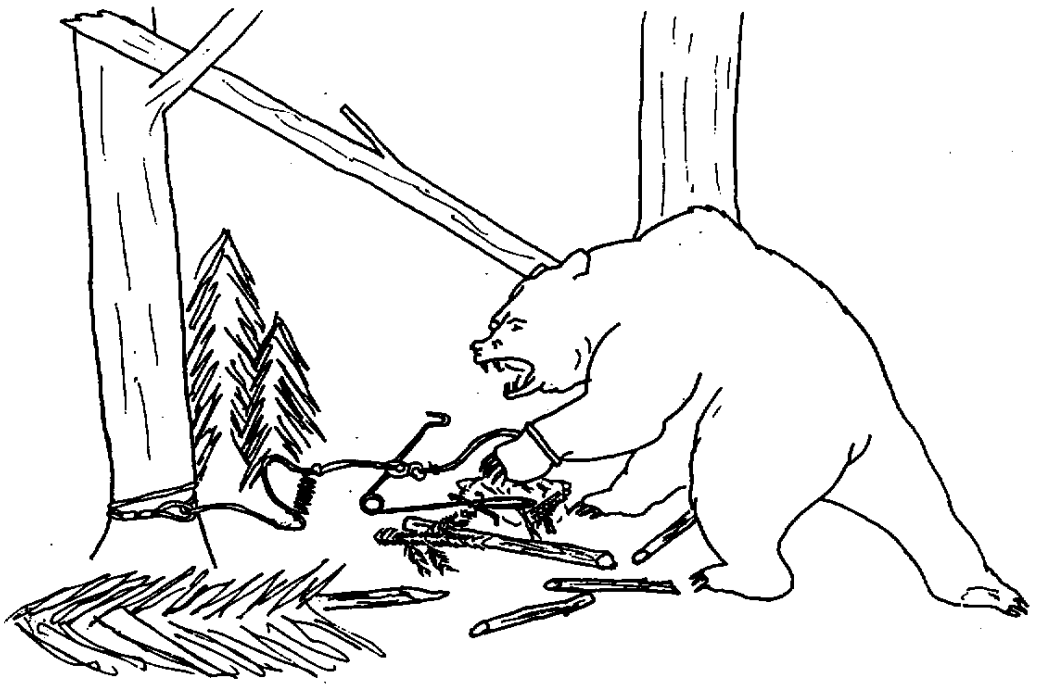

Figure 7. Bear captured in a snare rigged with a car hood spring to prevent injury.

PUTTING TOGETHER A DRUG AND HANDLING KIT

General Notes

Above everything, consider safety to the crew and the bear when putting together a drug and handling kit. You should be equipped to handle most conceivable situations for drugging a bear, and know what to do in emergencies. You will need a variety of chemical agents and equipment to handle both standard bear captures and delicate handling predicaments. For example, you may have to free-dart an adult male that is guarding its mate, administer drugs to a bear in a back yard that is clinging to a tree, anesthetize a bear that is injured, sick, or suffering from severe infection, or immobilize a moose or elk that is trapped in a snare.

It is important to have an efficient and well organized kit that can be placed in a backpack or tackle box. To make things easier to locate, the equipment for each procedure can be stored within a series of labeled containers or sacks within the kit. The drug kit should contain everything needed to drug at least five bears, and the handling kit (see Handling Bears) should contain everything that is necessary to collect biological samples and treat injuries and anesthetic emergencies (see Appendix V for list of items). There should be extra supplies available at the field camp or office. All the equipment should be maintained, clean, and of good quality.

Immobilization Equipment

A wide variety of drug delivery devices are available today, but not all of them are suitable for bear research and management. Basically, bear handlers must be able to drug bears from 5 feet to 30 yards away. Most bears are drugged with the Cap-Chur darting system, the blow gun dart setup, or by some type of jab stick. Other darting systems are available as well, such as Pax-Arm and Pneu-Darts, but have received only limited use on bears.

Most drugging can be done with a close-range drugging device such as a jab stick. Some situations require the use of a long-range darting rifle. While this method is less dangerous to the handler, it is potentially more dangerous to the bear because exact placement of the dart is more difficult. On a regular basis, especially before starting the field season, practice shooting whatever dart guns or blowguns you may be using. To save room and reduce weight, a rifle's wooden stock may be replaced with a lightweight wire or plastic stock that can be screwed in place.

The Palmer Equipment Company's Cap-Chur darting system is the standard in the field of wildlife immobilization. The very diverse .50 caliber Cap-Chur dart can be used in a close range pistol or attached to a jab stick. The dart can also be fired at distances over 30 yards through a variety of darting rifles.

The Cap-Chur darting system is widely used and parts and

equipment are easily obtained. This dart setup is simple and offers bear handlers more alternatives then other darting systems. Also, unlike the blow gun, most people are already familiar with the use of a pistol or rifle, and therefore feel more confident with this method of drug delivery. Aluminum dart materials are very durable and can be used repeatedly (see section on preparing Cap-Chur Darts).

One disadvantage of the Cap-Chur dart setup is that the expulsion of liquid during injection causes bruising and tissue damage. When the dart strikes its target, the internal Cap-Chur charge is detonated, driving the plunger and fluid forward. The drug is expelled through the needle into the muscle in 0.01 seconds. In addition, the impact of the Cap-Chur dart may cause serious tissue damage if exceptional power is used to propel the dart. Cap-Chur darts, especially when fired from a Palmer rifle with .22 blanks, have been known to bruise and imbed in muscle.

The drugging kit should include a variety of Cap-Chur dart supplies. Have a selection of 1 through 10 cc dart cylinders, 1/2 to 1 1/2 inch Cap-Chur needles (barbed, collared, and smooth styles), plastic and cloth tail pieces, plungers, and 1-3 cc and 4-10 cc internal Cap-Chur charges. A wet stone (for sharpening needles), two positioning rods, and sterile jell should also be included. It is important that the capture charges are stored in a water-tight container with a moisture absorbing Humi-Cap.

Palmer Rifles

Cap-Chur darts are propelled from the gun by the release of gas pressure from a selection of .22 caliber blanks that fit into the rifle's special .22 adapter. Only two of the available charges are recommended for use on bears: brown charges (10-30 yards) and green charges (20-40 yards). Occasionally there may be a need for yellow charges (40-60 yards), but they are not recomended for most capturing and handling situations. The high power red charges (60-90 yards) have been responsible for the death and injury of too many bears and should <u>not</u> be included in the drug kit.

The accuracy and firing distance of the rifle is usually exaggerated. There is tremendous variation in the power of the powder charges, especially if they have become damp. When the charges are weighed individually, there is a often a noticeable difference weights. Any .22 charges above or below the average weight should be discarded.

When purchasing or selecting a Palmer rifle, make sure the gun shoots darts accurately. There is a variation in the shooting ability of these rifles and it may take hours of practice on the range to become familiar with the gun's capabilities (Day 1969). Sight the rifle in at various distances using the different charges and various sized darts filled with water. Also position the darts at different depths down the barrel with a glass positioning rod to get a feel for how that influences the dart's velocity. When possible, try practicing on an animal carcass.

The Palmer rifle kit should include an extra .22 adapter, .22 powder charges (brown, green and maybe yellow), a practice dart and a cleaning rod with oil, solvent, and a copper brush. Always store the powder charges in a water tight container with a Humi-Cap to absorb moisture.

CO_2 and Air Pistols and Rifles

Air and CO_2 pistols are very handy for close-range drugging of bears in snares and culvert traps. Pistols are light and take up very little room in the drug kit. Pistols are accurate up to 15 yards. If a bear in a snare is uncomfortable with your closeness, the dart can be removed at the last minute and transferred to a rifle.

The CO_2 powered rifle and air pump-up rifles can be used for long distance drugging, but they don't have the range of a Palmer powder-charged rifle. At best, these rifles are accurate to about 20 yards. The accuracy and velocity of CO_2 powered guns is variable and depends a great deal on the pressure of the gas cartridge and the ambient temperature. The drug kit should include extra CO_2 charges and an extra seal for the gun's pressure compartment. Although not as powerful as a Palmer rifle, it is still possible to imbed darts in bears with a fresh CO_2 cartridge at the higher setting.

Jab Sticks and Syringe Sticks

Palmer Equipment Company sells a jab stick that is compatible with the Cap-Chur dart. A suitable device can also be built from an aluminum arrow shaft, a screw-in field blunt, and a 6-10 foot 3/4 inch diameter high-strength aluminum pipe or broom handle-sized pole. The arrow shaft can then be taped to the wooden pole or epoxied inside the pipe. At least 5-6 inches of the front of the arrow's shaft should be sticking above the pole. The Cap-Chur dart needle, cylinder, and plunger assembly can then be placed onto the end of the arrow's field blunt and used as a jab stick (Fig. 8).

To make a syringe stick, find a 6-10 foot pole and whittle one end flat. Pick out a sterile disposable syringe (Leur-Lock syringes are best) large enough to hold the drugs needed to immobilize the bear and securely tape the thumb piece of the plunger's post to the flattened tip of the pole (Fig. 9). Be careful not to pull the syringe apart or tape too far up on the stem of the plunger. Electrician's tape works the best. Put a 1 1/2 inch 18-20 gauge needle tightly onto the syringe. Larger gauge needles should not be used as they will not pierce the skin as easily, causing some drug to squeeze out on the hide. Smaller gauge needles break too easily.

Select another disposable syringe that is the next size up and take it apart. Place the incremented syringe barrel over the

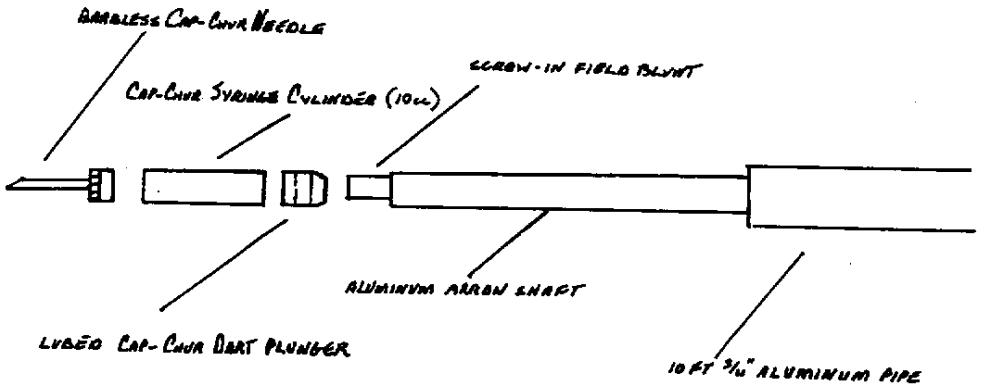

Figure 8. Diagram for a Cap-Chur Jab Stick.

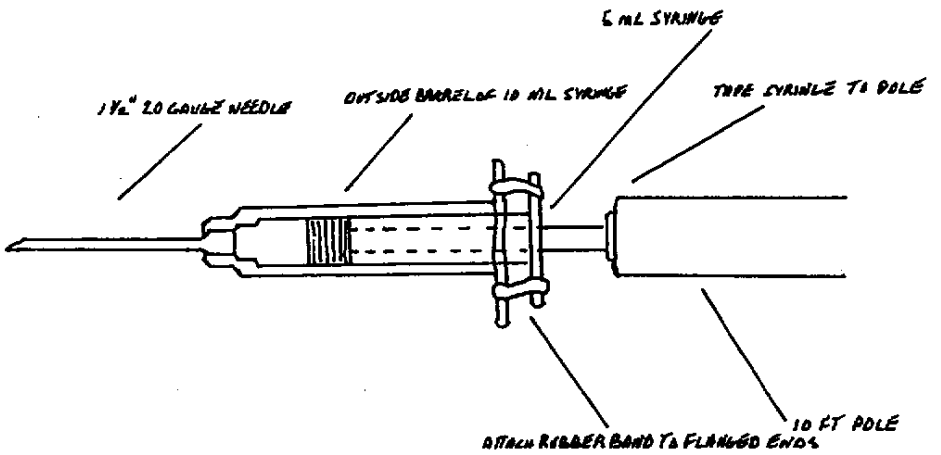

Figure 9. Diagram for constructing a syringe stick.

needle and syringe that is taped on the jab stick. With a rubber band, fasten the flanged ends of the two syringes together. This gives the needle strength and additional support. You now have a strong syringe stick that can be used to drug the bear. This is not a jab stick and should not be forcibly driven into the bear as the needle may break or bend.

There are other jab stick and syringe stick assemblies. These two methods, however, are the simplest and most sanitary.

Blow Guns

Many bear handlers prefer using a blow gun to dart bears at close range.
The advantage of the blow gun setup is that the bear can be darted almost anywhere without harm. A bear can be hit in the ribs or stomach muscles with a blow dart with little risk of serious injury (Carriles 1990). The blow gun is simple to use, inexpensive, and easy to purchase or build. There are no mechanical parts requiring maintenance, and it has a maximum range of 15 yards. The darts used in blowguns can also be used in modified pump-up air guns.

In dangerous situations, the blow gun darting system is not acceptable. Therefore, it is recommended that a Palmer rifle and Cap-Chur darts always be on hand. As a result, the paraphernalia for both darting styles needs to be present in the drug kit. Although this allows biologists and managers more choices and alternatives when drugging bears, it also increases the amount of equipment.

A blow gun can be purchased (Palmer Equipment Co.) or made out of 5/8 inch PVC pipe and the darts can be ordered or built out of 3 ml syringes and 18 gauge needles. These darts are compatible with any air rifle that fires the .50 caliber Cap-Chur dart. If a larger blow dart is desired, a larger caliber air-rifle and blow gun will have to be purchased or made. Although not as durable, the plastic blow darts are cheaper than Cap-Chur darts and are easily made. (See Appendix II for information on one method of constructing a blow gun and blow darts).

If this method is used on bears, the drugging kit should include a blow gun, at least four blow darts with needles, and a canister of butane. Butane or air is used to charge the dart.

Drugs

To prevent breakage in the drug kit and unintentional exposure, all drugs should be stored in a hard container with padding. It is recommended that a variety of drugs be placed in the drug kit to handle bears. Currently, the dissociative drug/tranquilizer mixtures Telazol and Ketamine/Rompun are the chemical agents of choice for handling black bears and grizzly bears. Each of these mixtures, which are discussed later, have

certain qualities that are beneficial to bear researchers and managers. If only one drug mixture is to be carried in the drug kit, Telazol has the most desirable attributes. A six-pack of cranberry juice should also be with the drug kit in case there is an accidental human drugging. The high pH of the juice counteracts the effects of dissociative drugs (see Appendix I for treating human exposure to drugs).

None of the opium-based drugs such as Carfentanil or M-99 are recommended for use on bears in the field. A 50 ml bottle of Rompun should be in the kit to immobilize any ungulates that may get caught in snares. (See Appendix I for Immobilizing and Releasing Non-Target Animals.) If concentrated Ketamine/Rompun is used, include extra vials of commercial Ketamine for extending a bear's down time. A large bottle of sterile saline solution will be needed for mixing dehydrated drugs and to increase the liquid volume in darts. If urine samples are required include a bottle of Lasix, a diuretic recommended for bears. The mock antagonists used with Ketamine/Rompun mixtures and Telazol (Yohimbine and Dopram), should also be included. Dopram should always be in the kit because of its value as a respiratory stimulant. A long-acting antibiotic that remains stable at room temperature, such as LA-200, should also be included in the kit for use on any injured or ill bears.

The kit should also include a variety of disposable syringes and needles (3 ml to 10 ml). Twenty gauge 1 1/2 inch needles are adequate for most purposes. If preferred, other needle sizes and gauges can be included. Disposable rubber gloves are highly recommended for handling drugs and instruments. A roll of electrician's tape should be included for taping syringes onto syringe sticks.

CHEMICAL IMMOBILIZATION

History of Chemical Immobilization

Drugs have been an integral part of Man's life since the dawn of humankind. Curare, a paralyzing drug rendered from various plant species in the family Strychnos, is just one example of primitive man's use of chemical immobilization as a tool for hunting. The discovery of the fermentation process and alcohol stupor, is another example.

Ether anesthesia, noted to have an effect on fowl in 1540 by the Swiss physician Paracelsus, was the first chemical agent bottled and produced for the purpose of anesthesia. Dr. C. T. Jackson, a Boston physician in the 1840's, was the first to use ether to any extent on animals. The first human operation was performed by C. W. Long in 1842. Next came chloroform, then morphine, then laudanum and finally cocaine in 1860. By the middle of the twentieth century, anesthesia had developed into a fine art.

Albert W. Erickson, who in 1952 started the first serious bear research, clapped ether-soaked rags over the muzzles of his snared black bears. Before pioneering bear research with chemicals such as nicotine and succinylcholine (Seal 1985), immobilizing techniques included such things as choking down of bears with chains or cable or the use of chloroform, carbon dioxide or nitrous oxide (Skjonsberg and Westhaver 1978).

General Considerations About Drugs

Every day, men and women die in North American hospitals during anesthesia. The Veterinarian's Association reports losses of hundreds of anesthetized animals every month. Even with today's technology, anesthesiologists lose patients to allergic reactions and unknown factors.

Medical professionals are intrigued with the low number of immobilization-related deaths in bear research, especially when considering the lack of training, inconsistency in handling techniques, and uncontrollable environments. Bears are highly evolved physiologically, and never cease to amaze the scientific community. The never-ending quest for better anesthetic agents and techniques has been beneficial to bear research. In the last five years, drugging and handling methods have matured considerably, but improvements have come about in a haphazard fashion. The politics, emotions, and legalities associated with bears has forced researchers and managers to become more organized and give greater emphasis to bears' health and to human safety.

Bears are unique research animals because they are so highly regarded by the majority of the public. Managers must invest more time in public relations to assure people that bears are not being handled needlessly, and that every care is being taken to minimize pain and suffering. People who are not willing to take every

precaution to prevent harm to the animal should not be trapping or handling bears (LeCount 1986).

The main drugs used on bears today (tiletamine and ketamine) are in the Cyclohexamine family. Some research has been done on drug-altered behavior in bears, but it would be of value to further explore the behavior and neuroendocrine physiology of trap-prone bears repeatedly dosed with these dissociative drugs (Seal 1985).

Unlike humans and other species, bears have a high tolerance to drugs. Unless a bear is repeatedly given large drug volumes over a constant period or the oxygen supply is reduced, it is unlikely that brain damage will occur from just a few drugging episodes (Lumb 1963). New research findings raise questions regarding the pathological changes induced in cerebrocortical neurons of rats by dissociative anesthetics (Olney et al. 1989). The fact that no true antagonists have been found for this drug family reflects the uncertainties concerning the mechanism of dissociative agents (Seal 1985).

There are other factors to consider when using chemical restraints on bears. For example, a bear released under the effects of a drug is unable to protect itself from other bears that may be at the release site. It is important that the handler watch the study animal when possible until it is up and moving. This is especially true when the bear is released at a baited trap site or in an area with high concentrations of bears. Bears will kill other bears, when given the opportunity.

As with other species (Schurholz 1974), sexual patterns might be altered when a bear is under the effects of a drug. This is especially true during the spring mating season. Females in estrus may be vulnerable to the sexual advances of males, or to females exhibiting competitive behavior. Also, there is the possibility that certain drugs may cause hormonal changes, activation of perineal glands, or stimulation of the cerebral sexual center (Schurholz 1974). Yohimbine, or Antaganol, is a good example of a drug used in bear research that has supposed aphrodisiac properties.

As a rule, never mix drugs or use two different restraint drugs on the same bear during the same day. Keep thorough records if you must use different drugs in combination because of an emergency situation, and document any adverse reactions. It should be noted that Ketamine and Telazol have been used in combination in emergency situations with success.

All drugs used for immobilization purposes must be purchased and prescribed through a licensed veterinarian, or through an agency registered with the Federal Drug Enforcement Administration (DEA). Several drugs used in wildlife research are so restricted they can't be prescribed even by a physician. These chemicals are potent, dangerous and have a high black market value. M99, Carfentanil, their antagonists, and Sernylan, are all classified as "abused drugs" by the DEA and are subject to both federal and state regulations (Schedule I, II, and III of the Controlled Substances Act of 1970). Drugs that are scheduled will have a Roman numeral surrounded by the letter "C" on the label.

If any controlled substances are misplaced or stolen and then later appear on the streets, the researchers responsible for the drugs could be found criminally libel in court. Because of this, Arnold Melnikoff (former manager of the Montana Crime Lab) recommends that drugs classified as Schedule I substances (the morphine and synthetic opiates) not be used in the field.

Sernylan was one of the first cyclohexanone compounds to be widely used as a wildlife immobilizing agent and was used to drug thousands of black, grizzly, and polar bears. Although few, if any, psychological effects were observed in bears (Seal 1985), street abuse of the drug escalated. Known as PCP or "angel dust" Sernylan (a Schedule II narcotic), was sometimes found to cause extreme behavioral changes in humans when taken at sub-anesthetic doses. Some abusers were turned into violent paranoid schizophrenics. Although this drug has qualities that may be desirable for certain bear management situations, it is no longer commercially available.

The most highly potent narcotics used by researchers and managers are synthetic derivatives of morphine (Schedule I and II drugs). Etorphine, or M99, is 100 to 300 times more potent than street heroin. Carfentanil is 10 times more powerful than M99 (Melnikoff 1987). Also, these drugs are very lethal to humans. The M99 dose needed to immobilize a bear is 50 to 100 times the amount needed to kill a person. Both M99 and Carfentanil can be absorbed through the skin. Not surprisingly, these drugs are not recommended for use on bears in the field.

Ketamine is frequently abused by people. Melnikoff (1987) stated that several people have overdosed on this drug, and that it has roughly one-third the hallucinogenic properties of PCP, which tempts people to take more. Because of the abuse of zolazepam (which is similar to Valium), Telazol is currently a Schedule III drug. Ketamine and tiletamine will probably become controlled substances in the near future, but are currently not listed. Other types of tranquilizers and antagonists commonly used in animal research are frequently stolen from veterinarians and stock yards and sold on the black market. It is imperative that bear handlers keep good drugging records and guard against theft. A charge of Civil Liability could result if any drugs were stolen and abused.

Many wildlife biologists and bear managers are too careless and indifferent with drug storage. Drug kits, when not under observation, should be locked in a secure area. Reserve stocks should be stored inconspicuously but securely, preferably in a safe mounted to the floor in a closet. When on the road, place drugs in a locked container within a locked vehicle. A biologist doesn't have to give drugs to someone to get in trouble with the law; he or she just has to make them available. The best way to dispose of expired drugs or empty bottles is to give them to a veterinarian, local hospital, or law enforcement agency.

Researchers should keep thorough records of drug inventory and document any misplaced drugs. All drug dosages should add up on trapping records, and any drugs loaned out or disposed of should be noted. Be aware that if someone overdoses from an unaccounted drug source, the DEA will be making its own inventory.

When working with bear populations that are hunted, managers should be prepared to answer the public's questions about consumption of previously drugged bears. It should be noted that very little research has been done on this topic. FDA rules specify that animals drugged with ketamine or tiletamine should not be slaughtered for consumption within 30 days. Whenever there is a doubt, hunters should be told not to consume bears that have recently received a restraint drug. Most drugs injected into muscle are detoxified in the liver, and residues are excreted through the urine in approximately 48 to 72 hours (Orr pers. comm.).

Common Immobilizing Drug Mixtures for Bears

The drugs discussed in this section are all dissociative anesthetics. These chemicals are absorbed into the bloodstream from the injection site and reach the brain where, based on their molecular size, pH, and charge, they act at various sites and depress the activity of nervous tissue producing anesthesia.

Paralytic drugs, like curare, sucostrin and nicotine alkaloid, are not humane and should never be used. These chemicals produce muscle paralysis by blocking nerve messages to muscle tissue; they do not produce anesthesia. M99 and Carfentanil have desirable qualities, but are too dangerous for use in the field.

The most desirable form of anesthesia for bears is one that:

1) depresses the activity of nervous tissue, making the animal oblivious to pain;
2) causes narcosis, a deep sleep;
3) has no ill side effects;
4) has a short induction period;
5) has a down time of one to three hours;
6) permits the drugging of large bears with small quantities;
7) has an antidote that reverses the effects of the drug; and
8) has a wide safety margin.

Tranquilizers should help the animal relax, compensate for any side effects caused by the immobilant, and be of a high enough concentration so that they can be delivered with the drug simultaneously. It is also important that all chemical agents be stable and remain in solution at room temperature for long periods of time. The drug mixtures Telazol and Ketamine/Rompun fulfill most of the above requirements.

Telazol

In the last ten years, thousands of bears have been immobilized with Telazol (Sterling et al. 1985, Amstrup 1987, Haroldson 1988, Taylor et al. 1988). This drug has a wide margin of safety and does not affect respiration, thermal regulation, or cardiac activity. It is the safest, most humane, and least variable drug for bears in the cyclohexanone group. Telazol is safer than Ketamine/Rompun because the depth of anesthesia does not have to be

constantly checked and the bear comes out of anesthesia slowly. Also, there have been no documented incidents of explosive arousal with this drug.

Telazol is readily available, widely used, and has a long shelf life in powdered form. It can be mixed to high concentrations (up to 500 mg/ml) and delivered in small volumes. This is especially helpful for drugging bears with the smaller blow darts. Multiple doses are usually not a problem. Although not a true antagonist, Dopram can be used to reverse the effects of Telazol.

Telazol is cycled through the body fairly rapidly when compared to drugs such as Sernylan; therefore, multiple doses are required when the animal needs to be immobilized for extended periods. As with any drug, certain bears, especially adolescents, occasionally fail to respond to this chemical restraint.

Telazol has been produced since the 1960's, but has only recently been commercially available. Telazol is sold by A.H. Robins in 5 ml vials in a dry, powdered form containing 500 mg of tiletamine hydrochloride and zolazepam hydrochloride. One to 5 mls of sterile isotonic water is added to each vial, depending on the desired concentration. The mixture has excellent solubility, and has a reconstituted stability of at least 4 days at room temperature or 2 weeks if refrigerated. Partially used bottles should be clearly labeled with the drug concentration and the date when the bottle was hydrated. Discolored drugs should not be used.

Tiletamine HCL is a cyclohexanone dissociative agent that is an analogue to Sernylan and Ketamine. Used alone, tiletamine causes convulsive seizures in some animals. Zolazepam HCL, a diazepinone tranquilizer, is an excellent muscle relaxant and anticonvulsant. The combination of the two drugs capitalizes on the desirable qualities while minimizing side-effects.

Recommended Dosage

The recommended dosage of Telazol for grizzly bears ranges from 2.5 to 4.1 mg/lb (Taylor et al. 1988, Haroldson 1988, Aune pers. comm.). The IGBST's initial Telazol dosage for all bears is 250 mg of Telazol/100 pounds. Once the bear is "down," it can be given more drug by hand injection if a surgical plane of anesthesia has not been reached. When additional doses are needed to prolong or deepen anesthesia, half the original dose is recommended (Schobert 1987). The median total dosage for all grizzly bears handled by IGBST was 3.7 mg/lb.

To keep the drugging process organized and simple, IGBST adds 2 mls of sterile water to each vial of Telazol for a total concentration of 250 mg/ml. That way, leftover vials of Telazol will always have the same concentration. Dosages are simplified by giving 1 ml/100 pounds for all bears. Recent data indicates that the optimal Telazol dose for grizzly bears may be closer to 4.0 mg/pound (Aune pers. comm.). In this case, Telazol mixed with 1.25 mls of sterile isotonic water will have a concentration of 400 mg/ml. While this concentration may work great on larger bears (due to the reduced volume), it should be noted that significant amounts of the drug may remain in the dart or needle when dealing with

small volumes intended for small bears.

Higher drug concentrations are handy whenever there is a desire to minimize the amount of volume required, especially for large bears. However, there may be a problem with higher concentrations staying in solution, especially in cool weather. At these times vials should be agitated and kept warm just prior to use. One ml of sterile water is enough to hydrate an entire 500 mg vial of powdered Telazol. Be aware that the liquid volume extracted from a bottle of Telazol is slightly greater than the volume of sterile diluent that was added. The higher the concentration, the greater this difference (see Appendix IV for various Telazol dosages).

Induction, Down Time, and Recovery

Induction times for bears are generally 3 to 8 minutes (Taylor et al. 1988, Haroldson 1988). With Telazol, grizzly bears remain anesthetized for 45 to 211 minutes, depending on the dosage, and recover from the drug fairly slowly. However, even the most deeply drugged bears recover totally in 3 to 4 hours (Taylor et al. 1988, Amstrup 1987).

Bears drugged with Telazol should be tested every 10 minutes for signs of arousal. Signs of recovery include head and paw movement, lip and nose twitching, and reaction to sound. Complete recovery occurs roughly 20 to 30 minutes after the bear begins raising its head from the ground. Occasionally, bears will sleep off the effects of the drug and not show early signs of recovery. Any bear exhibiting sleeping behavior after the handling procedures are accomplished should not be approached on foot.

Antagonists

Although not a true antagonist, the respiratory stimulant Dopram (Doxapram Hydrochloride), was found to be effective in countering the effects of Telazol. Results indicated that a dose of 2.5 mg/pound of Dopram produced good respiratory stimulation and prompt arousal without relapse or undesirable side affects in dogs (Hatch et al. 1988). A grizzly aroused with Dopram may move off a short distance and then again fall under Telazol's effects. Dopram is sold in a concentration of 20 mg/ml. The dose of Dopram as an antagonist for bears has not been properly researched. However, dosages of 1.5 to 2.5 mg/pound appear to be effective. Although not yet commercially available, RO 15-1788 (an antagonist for zolazepam), may also have merit for decreasing anesthetic depression in Telazol (Bednarski et al. 1989).

Dopram is effective at alleviating most drug-related complications, especially those involving respiratory emergencies. As a result, it should be a part of every drug kit. It should be noted that rapid arousal is possible when bears are injected with Dopram. As a result, this drug should always be delivered IM rather than IV to prevent a rapid arousal, except in life threatening situations.

Ketamine and Rompun

A combination of ketamine hydrochloride (also known as Ketamine, Ketaset, or Vetalar) and Rompun (xylazine hydrochloride) can be used for most trapping and handling situations (Carr 1989, Haroldson 1988), and is especially useful when a minimal amount of down time is necessary. Bears immobilized with Ketamine/Rompun can be reversed with the antagonist Yohimbine (Antaganol) which acts primarily upon the Rompun. If bears cannot be attended to after handling, Ketamine and Rompun are an excellent choice. But if dealing with long handling periods or a delicate management situation (e.g. relocating a bear in a sling net with a helicopter), then Telazol should be used.

The mixture of Ketamine and Rompun is inexpensive, has a wide margin of safety, and is a quick and gentle immobilizing drug. The mixture has not been approved by the Food and Drug Administration for use on wildlife, but Ketamine is used on humans and dogs and is widely available. Ketamine is hallucinogenic, but not nearly as dangerous to humans as Sernylan.

It should be noted that the mixture of Ketamine and Rompun significantly depresses the cardiovascular, respiratory, and central nervous system of bears. For a half-hour to an hour, recovery symptoms might include rapid heart beat (tachycardia) and high blood pressure (hypertension). The major limitation to this combination is the prolonged depressant effects of Rompun upon the temperature regulatory system (Seal 1985). Yohimbine counteracts the negative effects.

Incidents of respiratory failure and vomiting with this mixture have been reported. When syringe sticking a bear, handlers should be aware that ketamine causes localized pain upon injection.

With Ketamine/Rompun the depth of anesthesia must be monitored constantly (see monitoring a bear). High tolerance has been reported in bears and other animals (Forlini et al. 1987, Haroldson 1988, Lynch et al. 1982). Also, recovery from this drug mixture can be immediate. When a bear shows the first signs of arousal, the area should be evacuated promptly or an additional dose should be given. Grizzlies have been known to recover in the middle of handling operations and subject handlers to great risk. Grizzly bears have a considerably higher tolerance for Ketamine/Rompun than do black bears.

The prompt arousal exhibited by bears is probably due to the different speeds the two drugs are metabolized - Ketamine is metabolized at a faster rate than Rompun. The later stages of immobilization is not true anesthesia, but rather one of Rompun sleep. To maintain anesthesia, multiple doses of Ketamine only will usually suffice (Aune pers. comm.).

Ketamine/Rompun is effective in denning work, but according to Fowler (1978), Ketamine may cross the fetal membrane and Rompun affects thermal regulation. Ketamine is frequently used alone to immobilize smaller bears, but is a rather slow-acting drug, does not produce skeletal muscle relaxation, and has a high incidence of

excitement and seizures or catatonia during recovery.

Ketamine is approved by the FDA for use in hospitals on children and high-risk patients. Rompun is a non-narcotic sedative, analgesic, and muscle relaxant. Rompun is preferred over other tranquilizers such as Valium and Acepromazine because of its analgesic and sedative qualities. The combination of Ketamine and Rompun produces a synergistic effect which increases down time. Ketamine and Rompun can be freeze-dried and later hydrated at higher concentrations, allowing larger bears to be immobilized with lower drug volumes. Commercial Ketamine and Rompun can be freeze-dried at a 2:1 ratio in any pharmacology lab. A dry mixture of 2000 mg of Ketamine and 1000 mg of Rompun rehydrated with 10 ml of sterile water (300 mg/ml total concentration) is recommended .

The actual stability of this concentrated mix in solution at room temperature is unknown. Trapping records indicate that the solution remains potent for months. At this concentration, however, precipitation may occur in cooler weather. The dry mixture is very stable and has a long shelf life.

Commercially available Rompun is sold in 50 ml vials in concentrations of 100 mg/ml. Commercial Ketamine is available in 10 ml vials and is also concentrated to 100 mg/ml. Both drugs are very stable at room temperature.

Recommended Dosage

The Montana Department of Fish, Wildlife, and Parks, which uses the concentrated 2:1 Ketamine/Rompun mix, initially doses black bears at 3 mg/pound, which allows for injections of 1 ml/100 pounds. Grizzly bears are dosed at 5.4 mg/pound or 1.8 ml/100 pounds. The dosage for black bears of commercially sold Ketamine and Rompun (100 mg/ml) should be 2 and 1 mg/pound (2 ml and 1 ml/100 pounds) and 3.6 and 1.8 mg/pound (3.6 and 1.8 ml/100 pounds) for grizzly bears.

When dosing large bears with commercial Ketamine and Rompun, it may be necessary to deliver the drug mixture in two doses. The first dose should contain all the necessary Rompun (which almost immediately begins to calm the animal), followed with the Ketamine.

Because of Ketamine/Rompun's variability, the IGBST, as a safety measure, occasionally administers an additional half dose of the mixture 20 to 30 minutes into the operation to prolong recovery for grizzly bears. The median total dosage for grizzly bears of Ketamine and Rompun was 4.5 and 2.0 mg/lbs. An additional dose of straight Ketamine is usually sufficient to prolong anesthesia. It is best to give additional doses IV. The effects of supplemental doses are not cumulative (Forlini et al. 1987; see Appendix IV for Ketamine/Rompun dosages).

A large bottle of Rompun should always be kept in the drug kit in order to sedate non-target animals like domestic cows and moose that are mistakenly captured. Rompun may appear to anesthetize animals fully, but any stimulation may cause an explosive arousal. The animal should be left alone until it is fully anesthetized. (See drugging non-target animals in Appendix I.) Rompun should not

be used alone to anesthetize bears, but it can be used as a tranquilizer to calm them in stressful situations. The recommended dose for bears is 0.9 to 2.7 mg/lb for sedation (Bauditz 1972).

Induction, Down Time, and Recovery

The induction period for grizzlies is roughly 8.5 minutes, depending on the individual bear and the dose (Carr 1989, Haroldson 1988). Black bears are immobilized within 6-12 minutes (LeCount 1986). The drug reaction causes a fixed expression of the eyes, salivation, and increased respiration. The bear loses coordination and begins bowing its head and neck just prior to immobilization. Eyes remain open and swallowing reflexes are not affected.

Down time depends on the individual bear and the overall drug dosage. LeCount (1986) reports down times for black bears of 45 to 60 minutes. IGBST data indicates an average down time of 130 minutes for grizzly bears that are routinely given a second, additional half dose.

Signs of recovery are indicated by lip, ear, or nose twitching, head movement, claw flexing, or reaction to sound. Within 3 minutes the bear could be too dangerous to handle. Everyone should either leave the site immediately or the bear should be given an additional dose.

Antagonists

Antaganol or Yohimbine (Yohimbine hydrochloride, manufactured by Sigma Chemical Company), reverses the affects of Rompun and allows the bear to regain muscle control (Garshelis et al. 1987, Ramsey et al. 1985). The median time until grizzly bears could stand after receiving Yohimbine IM on the IGBST is 15 minutes (Haroldson 1988). Be aware that the animal could revive immediately. Other alpha-2 adrenergic blocking agents similar to Yohimbine may also have merit for reversing bears drugged with Ketamine/Rompun (Seal 1985).

Antagonists are beneficial for most chemical restraints, but because bears drugged with Ketamine/Rompun have a relatively short down time and a rapid recovery, Yohimbine is rarely needed. It is useful, however, when a bear is having difficulty with the effects of Rompun or needs to be aroused quickly. The antagonist should be delivered IM to prevent the rapid recovery that would occur with IV injections. The recommended dosage is 0.05 mg/mg Rompun, or 1/20 of the total Rompun dose (Garshelis et al. 1987). Yohimbine is sold at concentrations of 5 mg/ml. (This works out to 1 ml of Yohimbine per ml of Ketamine/Rompun that is mixed at a 2:1 ratio and concentrated at 300 mg/ml. This would be 1 ml per 100 pounds for black bears and 1.8 ml per 100 pounds for grizzlies (see Appendix IV).

SAFETY CONSIDERATIONS

When working with bears, especially grizzlies, never rush into situations, make yourself available to the animal, or be overly casual. Too many bears have been killed because armed bear handlers and spectators have approached a free-ranging bear too closely. Never approach a trap site blindly, and only approach a bear when it is securely captured in a trap. When releasing bears from culvert traps, do so from the safety of a vehicle. Occasionally, because of poorly placed trap sites and tense management situations, chances will have to be taken. At these times it is important to be armed, ready, and alert.

Some people are so caught up with the fierce image of bears that they are prone to overreact. With the perceived security of a firearm, these types of people may become bolder, which could lead to the unnecessary killing of a bear. For example, a grizzly was killed in Canada by an individual who was checking traps with researchers. The trappers failed to properly communicate to this individual what was expected of him. As they approached the trapped bear, it charged. Not knowing where the trap was and not understanding the situation, the individual pulled up his rifle and killed the bear in the snare.

Never check traps or work on bears alone. It is also wise to have no more than 2 or 3 armed individuals at a bear trapping and handling episode. It just makes things too confusing and dangerous. The last thing you want to see behind you when a bear makes a sudden charge in a snare, is 7 armed individuals pointing guns in your direction. Before beginning any handling operation, one individual should be clearly in charge and team communication should be emphasized. The duties of each individual present should be outlined. Ideally, 2 armed individuals should work the bear while one stands guard in the background when handling grizzly bears. Less protection is necessary when handling black bears.

When to shoot an attacking bear is not an easy decision. Most of the surprise charges in the wild do not end in contact, but are rather false charges. When trapping, handling, and releasing bears, you should realize that the bears are under severe stress and trauma. Usually bears will flee, but occasionally one will attack with intent to cause harm. This is especially true when working with females that have cubs. Bears can move through dense brush at speeds up to 44 feet per second (Herrero 1985).

When a bear seems intent on causing harm, it should be killed immediately. Usually a serious bear will charge with its ears laid back and at a flat run. If a bear is close to taking someone or is on top of another person, kill the bear. Be extremely careful not to hit the victim. If the bear is mauling someone, you may have to run up to the bear and shoot it point blank. When shooting a bear, attempt to knock it down by hitting major bones in the front shoulders (Fig. 10). If it is still alive, the bear can then be dispatched with another bullet.

It is imperative that all firearms be well-maintained and

accurate. All persons should be thoroughly familiar and proficient with the weapons used during handling procedures. The gun you choose for protection should be based on what you feel most comfortable with. For example, shotguns should be the gun of choice for avid bird hunters and is preferred by most bear handlers. Large caliber rifles may be preferable for some big game hunting enthusiasts.

A 10 or 12 gauge pump or automatic shotgun loaded with slugs is an excellent form of close-range protection. Buckshot is not recommended, due to the situation in which a bear has to be shot that is already on another person. The risk of hitting that person would be much too great if buckshot were used. A high-powered pump or semi-automatic rifle with 200 to 300 grain bullets is more effective when longer shots may be necessary.

An alternative to carrying a pistol is to carry a can of Counter Assault (a red pepper spray distributed by Bushwacker Supply Co., Missoula, MT) that has been shown effective at stopping charging grizzlies. For greatest reliability, it is suggested that a new can be purchased each season.

Figure 10. Target area of a charging bear. When necessary, the best place to shoot a charging bear is in the large bones of the neck and shoulders (drawing by N. Wiegert).

ATTRACTING BEARS

One of the secrets to successful bear trapping is having access to good bait. Even the most wary bears usually think with their stomach. For example, if a bear is successful at getting to the bait at a trapsite without getting caught, it will usually return. If natural foods such as huckleberries and winter-killed ungulates are plentiful, however, no bait, scent, or other tactic will consistently attract bears. It is best not to use bait that can be associated with humans such as canned goods and garbage.

Sources of Bait

Road-killed ungulates are probably the best source of bait. In some states such as Wyoming and Colorado, it is illegal to use big game species for trapping bears. As a result, other sources need to be found. Slaughter houses, stockyards, veterinary clinics, sanitary landfills, local ranchers, and livestock allotments are good places to contact if a steady supply of animal carcasses is needed. Meat scraps and fruit can also be purchased from grocery stores or can be scavenged from garbage dumpsters behind supermarkets when nothing else is available.

Fruit can be an effective bait, especially apples, pears, and cantalope. Researchers in Idaho have had good success by using spawned-out steelhead and salmon from state operated fish hatcheries. Fish have been used by bear researchers in Wyoming, Maine and Montana, however, with little success. In Western Canada, while trapping an extensive area with helicopters, bear researchers had excellent trapping results with beaver carcasses collected from trappers. In the state of Maine, bears were attracted to traps with damaged potatoes donated by processing plants that were smothered with grease and molasses or honey condemned by the state.

If the trapping area lies within a wilderness area, all bait will have to be packed in with horses, back packs, or brought in alive. A horse can carry enough bait for roughly four to five trap sites. Old, sick, or crippled cattle and horses can also be purchased at reasonable prices and walked into backcountry areas and shot. When allowed, bait can be brought in by helicopter or dropped by airplane. Lightweight baits such as instant potatoes or grain mixed with scent, can be used in emergencies in backcountry situations if weight and bulk is a problem.

Storage of Bait

The storage of bait and scent can be a major problem. The last thing any trapping crew wants is a bear in the back of their truck or in camp, or an angry neighbor complaining about the odor. When possible, large amounts of bait should be collected before the

trapping season and stored in a freezer near the study area until it is needed. Powerful scents can be placed in small glass containers wrapped in plastic and frozen inside an airtight plastic bucket. Bait hauled in the back of trucks can be stored in garbage cans or small, plastic swimming pools. When packing with horses, bait can be placed in heavy rubber garbage cans and slung on pack saddles. Vehicles and equipment used to carry bait should be washed on a regular basis. In backcountry situations, all extra bait can be stored near one of the trap sites, in an extra culvert trap, or hung in a tree. Trap sites that are being closed should be cleaned up. If there is a possibility that a hiker or hunter will stumble onto the site before all the bait has been eaten or consumed, the meat should be removed, buried, or burned.

Scents

When working in the backcountry, it is sometimes impossible to keep a good supply of bait in the traps. As a backup, there are a variety of scents and lures that can be used as bear attractants. In some ways trapping with scent is advantageous because it is easy to carry and store, lasts longer, and quite possibly creates greater curiosity in bears. Fruit extracts, ethyl mercaptan (the agent used in propane to make it smell), synthetic pheromones, and bear urine are four especially overwhelming scent bases. These lures, when mixed with petroleum jelly, grease, lard, or cow dung, can be smelled for weeks. When mixed with such things as rotten meat, rotten eggs, pyridine, butyric acid, beaver castors, coyote, bear, skunk, or mink glands, dried bear droppings, or fish, the above scents become even more effective.

Baiting, Scenting, and Calling Techniques

Once a prospective trap site is chosen, pre-baiting the area before trapping is recommended. A burlap sack of meat scraps, a hide soaked in lure, a bottle of scent taped to a branch, or a deer hindquarter hanging in the air will be smelled from a distance and last longer than anything on the ground. Bait can be wired inside a locked-open culvert trap or a cubby structure to reward bears for visiting the site.

Pre-baiting can also aid the trapper in targeting certain segments of the bear population. By looking at hair, tracks, claw marks and scat at regularly checked bait sites, you can often determine the species, sex and size of the bears using the sites. This trapping technique prevents the capture of unwanted animals, saves time and drugs, and allows researchers to cover larger areas.

When trapping operations begin, animals can also be drawn to a bait station by dragging a hindquarter of a deer or scented piece of hide behind a horse or vehicle. In 1987, for example, the IGBST was able to watch several target grizzlies follow a scent line to

a bait site that intersected the bears' travel routes and feeding sites. Kerry Gunther, a bear management specialist in Yellowstone National Park, reported seeing a bear respond immediately after crossing an hour-old drag trail. It is recommended that anyone establishing a drag trail on foot be alert and watch for bear activity behind.

Bears will also key into noise. Ravens, eagles, and sea gulls will often stumble onto bait stations and natural carrion before other scavengers. The commotion they make seems to lure bears into bait stations from miles away. IGBST records and Aune (pers. comm.) also report that some bears appear to be attracted to a spot by the sound of gunfire. During the big game hunting seasons, bears are often reported using hunter's gut piles and carcasses. Predator calls will also attract bears, and a good imitation of a cub bawling will usually get a response from females with cubs. There have been many reports of bears responding to hunters bugling for elk, especially when cow and calf calls were also used. Electronic calling devices could be set up at trap sites.

There are a variety of theories on how to place bait at a trap site. Some trappers feel that it helps to lure a bear into a trap if you leave a series of food rewards in front. Other trappers feel this is not a good practice. Bait placed in front of a trap may stop a female bear, allowing a cub to get into the trap. Also, a food reward may slow one bear down when it is entering a culvert trap, allowing another bear to go in and spring the trap, causing the door to crash down on the first bear's back. In cold weather when scent of bait is weak, you can place yeast, bait, scent, and warm water in a bucket or plastic bag and let it brew. The mixture, which will generate its own heat, can then be placed at the trap site.

Once a bear is trapped and handled, the site itself acts as a lure. For some reason, trauma scenes are extremely tempting to all animals. A cubby and anchor tree ripped up by a snared bear, for example, will be visited by pine martin, bobcat, coyotes, and bears for many years.

SETTING CULVERT TRAPS AND SNARES FOR CAPTURING BEARS

General Notes on Trapping

Trapping may represent the most traumatic incident in a bear's life; therefore, it is important that all trapping is justified before it's conducted. Often bears are needlessly caught and relocated by bear managers who are simply eager to handle an animal. Usually, human/bear conflicts can be avoided by being patient, controlling people, and removing the source of the problem. If a bear is killing livestock, damaging apple trees, tipping over garbage cans, or getting into beehives, it may have to be trapped and moved. However, first talk to a calm, knowledgeable person at the scene and carefully analyze the problem before going out and setting traps. Your actions will depend on the situation and location. Attempt to solve the problem first by removing whatever attracted the bear to the site. For example, every year bears show up at private residences to eat apples in the fall. Rather than trapping and moving the bear, ask the homeowners to pick their apples. If that is not an option, you may want to consider aversive conditioning (Gillin et al. 1992, Hunt 1985). Only as a final option should a bear be trapped and relocated.

Selecting Trap Sites

When trapping grizzly bears, there is always the chance that a cub will be captured and that an angry mother will be guarding it. For this reason, all trap sites should be visible from at least 100 yards. Each trap site should have a clear approach and escape path. When possible, there should be a clearing large enough to drive a vehicle or land a helicopter in emergency situations. Avoid sites near creeks and in rough terrain. The noise of the water will keep you from hearing a captured bear from a distance, and the stream or cliff could be dangerous to a bear in a drugged stupor.

Each trap location should be carefully evaluated. Bears can be attracted away from creek-side travelways to appropriate sites with baiting. The site should be secluded and away from residential areas, campgrounds, and human trails. Keep well away from firewood gathering areas and popular fishing streams. Closed and gated logging roads are excellent places to set traps. If you must set a trap near a concentration of people or livestock for management reasons, close the area surrounding the site and monitor the trap. Also, the site should have good wind circulation to carry the bait's odor. The best sites for scent dispersal are in saddles at the head of connecting draws where air currents continually flow as temperatures change. Each trap location should have plenty of shade to keep captured bears out of the hot sun.

The location of a trap site is just as important as bait when attempting to capture bears. A site may be perfect in terms of

safety and appearance, but if it is not located in an area used and frequented by bears, it is of little use. Areas used by bears are recognizable by the amount of fresh and historic sign. If you find a place where you routinely see elk, moose, or deer, then you will probably find bears there as well.

Natural travel routes, when they can be found, are by far the best trap site locations. These corridors occur where traveling bears are "moved" through narrow strips of land. Obvious sites are mountain passes, major ridges, large gullies, and the junction of drainages. Natural and man-made barriers like the edges of large lakes, extensive open areas, rugged terrain, and highways will often direct bear movements. Aerial photos and topographic maps help in visualizing potential bear travel corridors. It should be noted that most bears will travel the path of least resistance, such as ridges, game trails, and old logger's skid trails.

By considering the bear foods available at certain times of year and setting traps in those respective habitats, you can increase the chances of catching a bear. In Yellowstone, for example, IGBST has had excellent success in late May and June by setting traps within elk calving grounds. In the fall, traps can be set where elk congregate to rut. In August, large groups of grizzlies congregate at high elevation sites in Wyoming to feed on army cutworm moths. Other productive, food-related trap sites may include big-game winter ranges in the spring, fish spawning streams in June, and dense berry patches in late summer.

Setting a Culvert Trap

Look for a flat, shaded site that is off the beaten path and accessible by vehicle. There should be enough cover so that the trap cannot be seen by curious observers. If possible, close the area. Post closure or warning signs on the trap and in at least four different directions surrounding the site. Back pastures on private land, old roads, and closed roads are examples of potential trap sites. Occasionally, traps will have to be set within city limits or in someone's back yard. In those cases the trap should be behind a building. Culvert traps in residential areas should be monitored closely. If a bear is captured, the trap should be moved into a garage or out of the area immediately. When possible, find where the bear is staying when it is not in town and set the trap there.

The rear of the trap (the end with the sliding door) should be pointed toward dense cover. In front of the trap there should be at least a 200 foot straight-away in the road leading away from the site. If the bear needs to be released from the trap with a long rope, you will then have an escape route should the bear decide to chase the truck. Also, always remember that an angry female or protective male could be guarding the site. The road or truck path leading to the trap should be fairly maneuverable. There should also be a turn-around for the truck at the site. Bears rarely attack vehicles, but such attacks have occurred; therefore, it is

recommended that you always have the truck pointed toward the escape route. If possible, there should be enough room to drive up next to the trap to check the door lock when a bear is captured.

If the culvert trap is unstable or too high off the ground, back the trap into holes dug out for the wheels and wedge logs under the door and beneath the trap. Raise the trap's door and spray WD-40 on the door runners and locking mechanism. Clean the bottom runner of the door frame. You do not want any debris preventing the door from locking shut when it drops. Sweep away any loose dirt, pine needles, grass, or snow from the entrance. However, a couple of shovels of dirt from the site thrown toward the front of the trap may assist in capturing wary bears.

Standard trigger mechanisms can be set off prematurely by curious bears. This can be prevented with an internal triggering device that consists of a set of vice grips and twine (Hoskins pers. comm.). Drill a hole through the handle and release mechanism on a pair of vice grips. Thread a piece of parachute cord through the hole and tie a knot at the end in such a way that the knot rests against the release mechanism. Attach the vice grips to the door frame. The vice grip's releasing mechanism should be pointed toward the inside of the trap. Tie a piece of bait onto the end of a 12 foot piece of cord and throw it in the back of the trap. Weave the free end of the cord through small pulleys or cord loops hanging from the ceiling and grate in the back of the trap and bring it to the front of the trap. Pull up the slack, and tie the cord onto the cord attached to the vice grips. Rest the door on top of the vice grips. When completed, the cord should run along the top of the inside of the trap (Fig. 11). Make sure a bear is unable to reach through the mesh at the back of the trap with claws and grab the bait. Also make sure the bait is swinging to prevent a bear from pressing it against the back and eating it from inside without releasing the door. Set the trap off several times to make sure the trigger mechanism is not set too soft or too hard and that the door locking mechanism works. The vice grips should hold the door up securely, even when the trap is shaken back and forth.

Tie some orange flagging to the top of the trap door so it can be clearly seen from a distance, or rig the trap with telemetry. Tape an old collar transmitter onto the door frame and tie a string to a magnet, which is taped lightly over the transmitter's internal switch. Then tie the string to the sliding door. When the door is released, the magnet will be pulled off and the collar will begin transmitting (Fig. 12). Culvert traps should be checked at least twice a day when set in an area frequented by people. Always be sure to remove the bait and lock the door shut with a padlock when the trap is not in use.

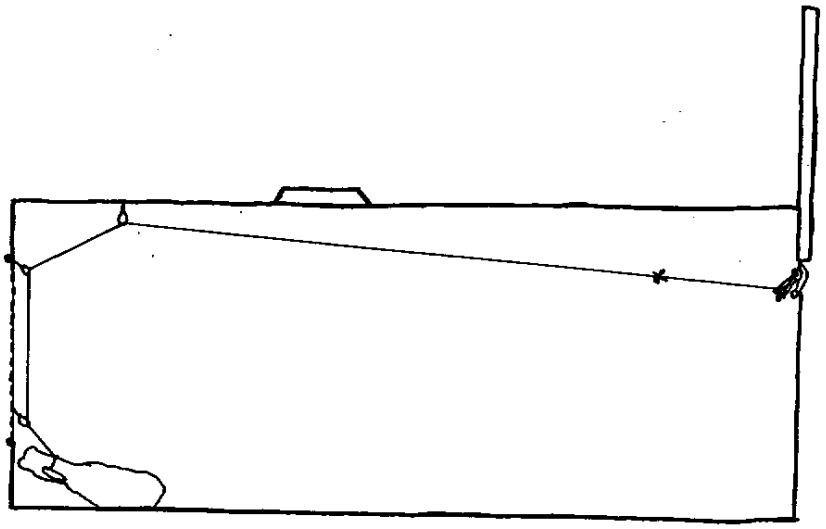

Figure 11. Internal trigger for a culvert trap using a pair of vice grips.

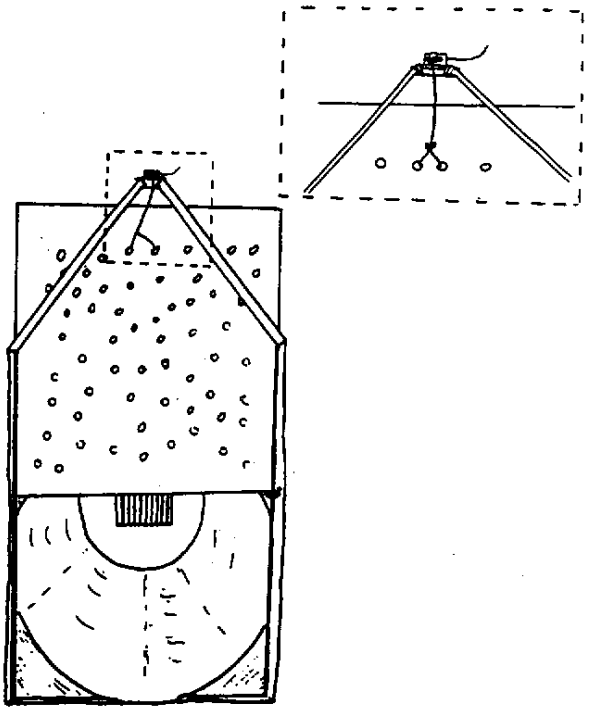

Figure 12. Culvert trap door rigged with telemetry. The string leads to a magnet on a transmitter. When the magnet is pulled off, the transmitter begins signalling.

Trapping With Snares

Many of the same criteria discussed earlier in selecting sites for culvert traps should be used when picking locations for snares. Find a shaded place off the beaten path that can be seen from a distance. The best sites can be checked by either driving a vehicle directly to the site or with binoculars from several hundred yards away.

A variety of sets are effective for capturing bears, and all of them require a solid anchor tree. The anchor tree should be alive and stout enough to winch a truck out of a mud hole. The tree should be solid with no sign of rot and a diameter of at least 10 inches at chest height. Bears have also been anchored to 55 gallon drums filled with rocks, to culvert traps, to large green logs, and to heavy machinery, but these should only be used as a last resort. If no suitable trees are available, large, commercial tractor weights are an excellent alternative. They can be easily buried and have rounded edges to avoid injuries or entanglement.

Always make sure the snare is positioned as close to the anchor tree as possible. Bears caught in snares with too much cable available have a much greater chance of hurting themselves or breaking loose. Don't hinder the action of the snare, but at the same time don't give a bear too much room to move after it is captured.

Snares should be set so that deer, elk, and moose will not be able to step into the trap. Cross poles can be laid across the set, and alternative paths can be made around the snare. Before setting any snare, check the trap over carefully for defects. If the snare is built with cable clamps, make sure the nuts are tight. Check the sliding mechanism of the loop. If needed, apply paraffin wax to the cable so the loop slides more easily. Attach the snare to the anchor tree, and check out the radius. Chop out any limbs on trees that a bear could climb over and get hung up on. Also cut away any small saplings or brush that a bear could twist the snare around. If a bear is able to twist the snare loop around a limb or sapling in front of the swivel, it could break the cable and escape with the snare attached to its foot.

It is a good idea to prop a pole with colored flagging tied to the top beside every snare set. If a bear is captured, it will almost always knock the pole down, alerting you in advance that a bear is in the snare.

Snares can also be rigged with telemetry. Tape an extra transmitter or radio collar to a log or limb. Tie a piece of string to the magnet that activates the transmitter and tape it lightly to the transmitter. Tie the other end of the string to the cable. When a bear is captured, the magnet will be pulled off and the transmitter will be activated. Make sure the transmitter is outside the bear's reach, or it will undoubtedly get chewed up. Several companies produce transmitters specifically designed for traps. A warning or closed sign should be posted at every snare site, with several additional signs placed in areas surrounding the site to

warn people of the trap's presence.

There are a variety of sets for snares, and no single technique is better than another (Flowers 1977). It is imperative, however, that you don't catch a bear too high on the leg or by a toe. After setting a snare, you should catch your arm to see where the snare tightens. The ideal catch is around the wrist. When tripping the snare, attempt to mimic the actions of an unsuspecting bear. If the snare grabs your arm above or below the wrist, you are probably doing something wrong (Fig. 13).

Setting the Snare

To set the snare, cock the spring and put the safety on. With the forks of the spring, find a spot in the soil free of rocks and roots. Pound the spring into the soil with the back of a hatchet. The spring's treadle should be flush with the ground. Lay the snare loop down from the left side of the spring through the notch built into the spring's throw arm. The loop's sliding mechanism should be on this side of the spring's notch and on the left side of the loop. When the loop is positioned and adjusted to the proper size (about 12 inches across), mark the spot in

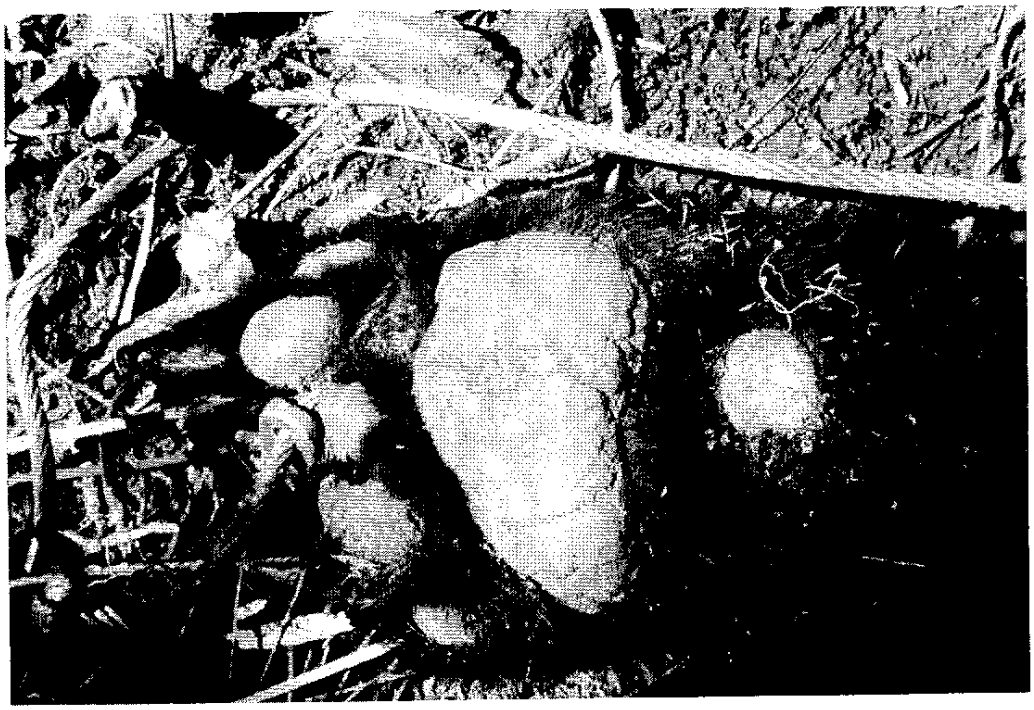

Figure 13. A black bear caught by two toes. This situation can be especially dangerous when dealing with a captured grizzly (photo by M. Burcham).

the soil and begin digging. The spring and snare can be removed or kept in place while digging the hole, depending on your trust in the spring's safety. The hole should be slightly smaller than the snare's loop and should be four to five inches deep. Never dig a hole too deep as it may cause a bear to be caught high on the leg. If the hole is too shallow, the bear could be captured by a toe. Care should be taken not to break down the side of the hole or loosen the soil that holds the spring's forks in the ground. Dig a small trough between the forks of the spring where the treadle mechanism sits. Make sure that no portion of the treadle is touching the ground. If necessary, build up the sides of the hole with sticks and moist soil.

The best way to prevent a high catch on a bear is to make sure the spring is positioned so that the arm will be thrown away from the bear, rather than towards the bear. Also, it is important to pin the snare tightly to the ground directly behind the spring's throw arm (Fig. 14). This holds the cable in place and allows the snare to pull up tightly around the bear's wrist as soon as the snare is sprung. Pin the snare cable to the ground with a hooked stick, metal tent stake, or a flat rock as close to the spring's notch as possible. Some trappers pin the snare down by placing the left fork of the spring through the swivel of the snare before pounding it into the soil or slip the snare under a small hook on the back of the treadle before placing the loop over the hole and through the throw arm's notch. When properly set, the treadle should be positioned horizontally about 1 1/2 to 2 inches below the loop.

Set the snare and, if necessary, test it over and over until it correctly catches you around the wrist. If the loop is lopsided, build up the lower side with dirt. If the loop is more oval-shaped then round, press some small sticks into the ground in front of the loop to help the loop hold its form. Lay some pencil thin sticks across the treadle as support for covering material. A thin stick can be used to prop up the tip of the treadle to prevent the snare from being set off by small animals, birds, or a heavy rainfall. Place the tips of evergreen boughs over the sticks and treadle, making sure everything is under the snare loop. If boughs are unavailable, moss, grass, large leaves, wax paper or a paper plate can be laid over the hole. Also, before laying down the cross sticks, handfuls of long grass can be folded in half and placed under the treadle with the fold facing up. Do not pack the grass too tightly or it may interfere with the action of the treadle. Sprinkle the entire area with fine dirt or litter. When finished, the set should have a flat, firm, natural appearance (Fig. 15).

A grizzly captured in a snare by one or several toes is very dangerous. To help prevent this, lay a network of branches and sharp pungy sticks around the edge of the snare loop. Make sure the sticks are solid, and that they will not fall or roll into the set. Cross two small, light-colored sticks just ahead of the

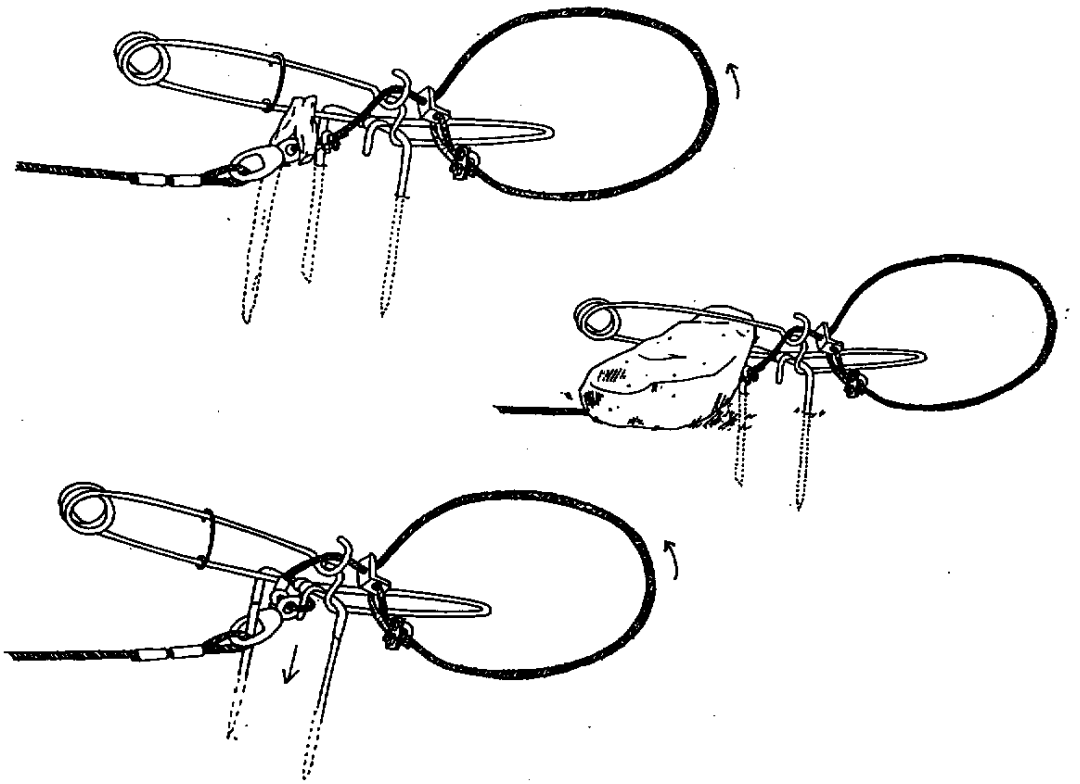

Figure 14. Three methods of pinning the cable to the ground (drawings by N. Wiegert).

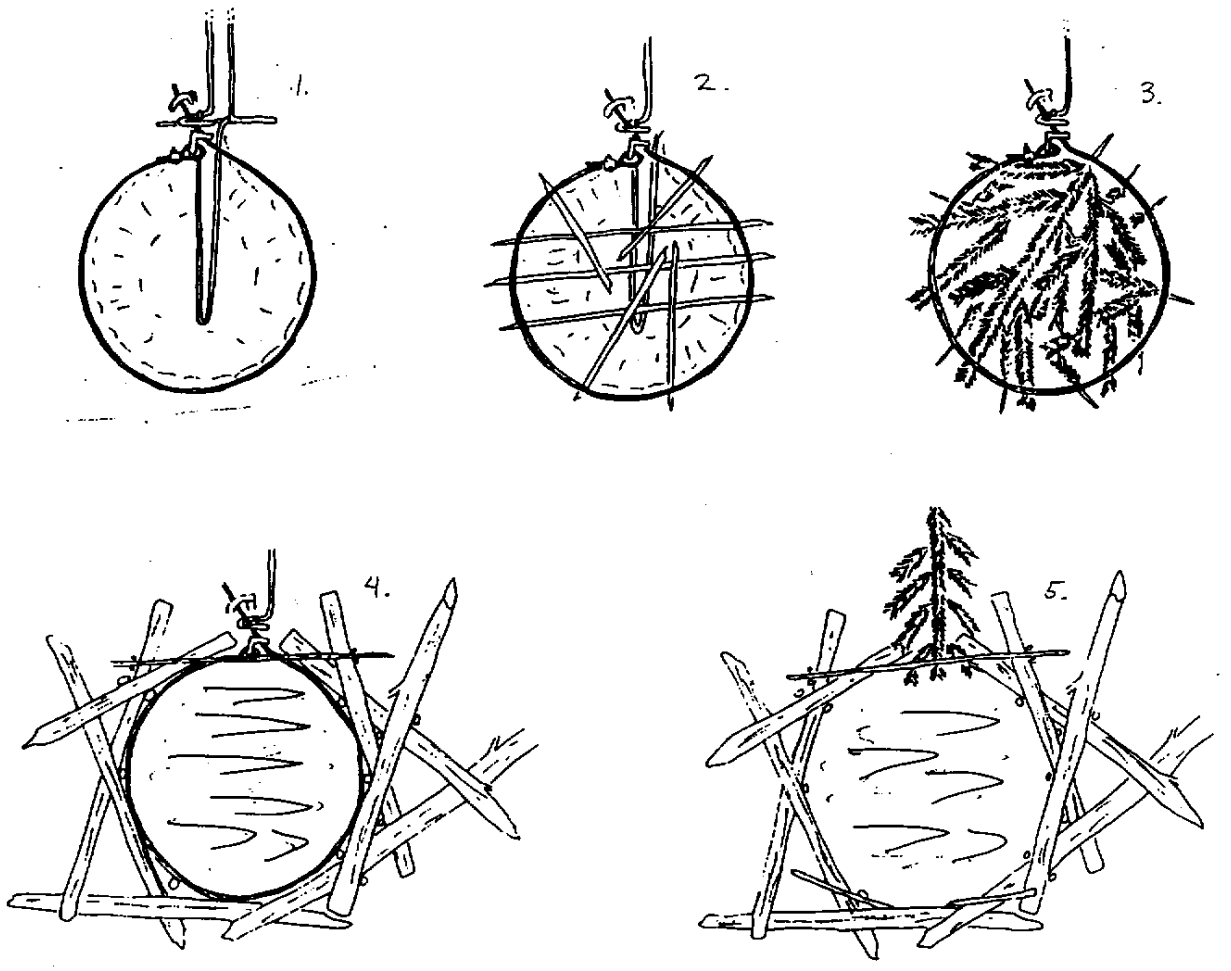

Figure 15. Various steps in setting a snare (drawings by N. Wiegert).

snare's sliding mechanism and the notch in the throw arm to prevent the bear from stepping too far forward. Remove the safety from the spring, and place a small stick over it. Cover the cable leading to the anchor tree with dirt, boughs, or litter. Place a small bough over the spring so it is less visible. Take every effort to conceal the snare, but at the same time be sure the snare's action is as unimpeded as possible. Look at the set carefully with your head about 3 feet off the ground, to get an idea of what it looks like from a bear's point of view. Make a bear trail leading into the set with your hands and stepping sticks before leaving the site.

Types of Sets

There are a variety of methods and techniques for catching bears in snares. The cubby set is very effective and probably most popular. The v-shaped structure itself acts as an attractant and helps guide the bear into the snare. The bait is placed in the back, and the snare is set at the mouth of the cubby. Make sure the mouth of the cubby is observable from a distance so you can see the bear and the snare clearly. If possible, the back of the cubby should be sloping slightly downhill to prevent maggots and bait from rolling into the snare. The cubby can be built around a single tree or several trees out of logs, poles, or rocks. A pole should be laid across the top of the cubby to keep ungulates out. Keep the logs of the cubby fairly short (< 8 feet long) to prevent the cable from getting tangled. It is very important the swivel action of the snare is not lost. Occasionally, a natural cubby can be found in downed timber or rocky areas. Cubbies are handy when trapping the same area year after year. The site can be pre-baited, encouraging bears to visit the site before snares are actually set (Fig. 16).

Barrel sets can be put in quickly and moved to other sites with ease. Place an opened 55 gallon drum next to a tree or between two trees and wedge it tightly in place with logs. Put some bait in the back of the barrel and conceal the snare at the mouth of the metal drum. Position sticks or rocks around the snare to direct the bear's foot to the center of the loop (Fig. 17).

Hanging sets are easy to build and the bait can be used repeatedly. Find a tree with a limb about 12 feet off the ground. Hang a hindquarter or a sack of bait over the limb and set the snare at the base of the tree in such a way that when the bear approaches, it will step in the snare. Make sure the bait is not hanging directly over the trap. Liquid soaked into the soil around the snare may cause the bear to spring the trap. Poles can be leaned against the tree to prevent the bear from coming at the bait from a different direction and to keep ungulates out (Fig. 18).

The trail set is very handy for catching unsuspecting bears. These hidden sets can be placed on trails along spawning streams, leading to dumps, and to trap and bait sites. Care must be taken to keep elk, moose, cattle, and deer out of the set. This can usually

Figure 16. An example of a finished cubby set (photo by T. Thier).

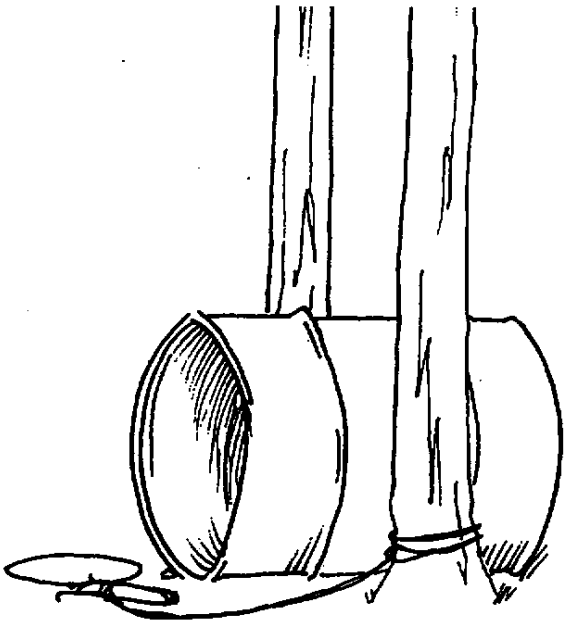

Figure 17. An example of a barrel set. A snare is concealed at the front of the barrel and sticks are placed directing where the bear should step (drawing by N. Wiegert).

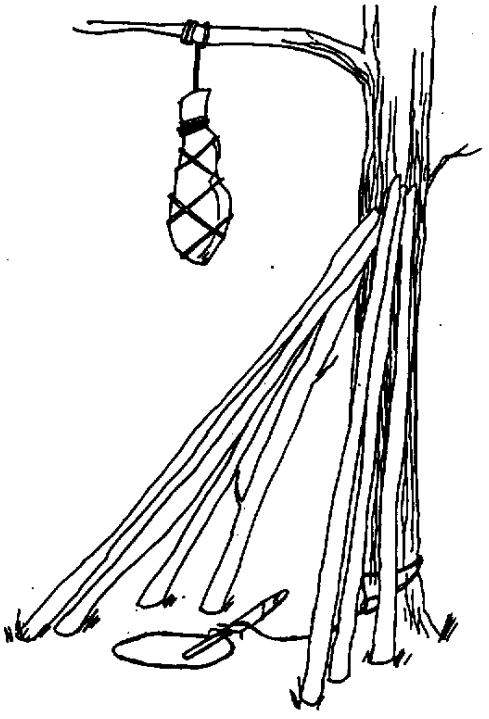

Figure 18. An example of a hanging set (drawing by N. Wiegert).

be accomplished by leaning a pole over the snare and against the anchor tree, or by tieing some poles in place with string. Never use wire or heavy rope, or the bear could become wrapped around the pole when caught. It is usually best to make your own trail by cutting away brush and small trees for a 30 to 50 foot distance, and then repeatedly dragging the trail with a large piece of bait (Fig. 19). If necessary, the trail you have made can be better defined by cutting small trees and positioning them along the sides of the trail by pushing their bases into the ground.

Dip sets are dangerous and have strangled several bears. The only time a dip set should ever be used is with utmost care when attempting to capture extremely trap-wise bears. Dip sets should be set in such a way so that a bear will be unable to get its nose down the hole and spring the snare. The hole should be deep, and the spring and snare loop should be down inside the hole below "nose distance." The spring's treadle should be angling down into the hole. The loop should be the same size as the inside of the hole (about eight inches across). In addition, two logs or rocks

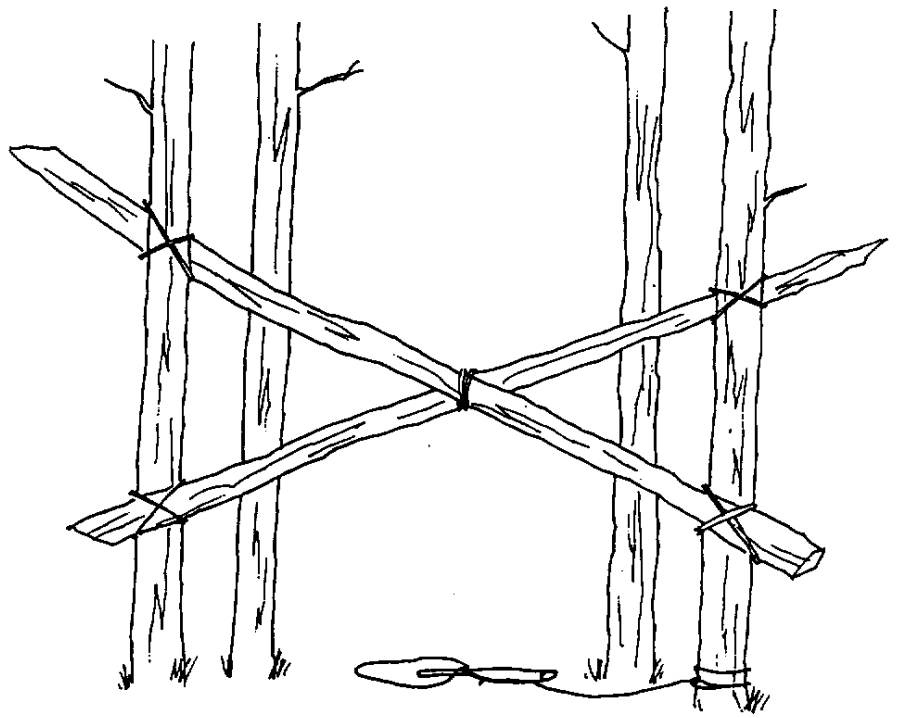

Figure 19. An example of a trail set. Use a breakable material if poles are tied in place (drawing by N. Wiegert).

should be placed along either side of the set to keep the bear from placing its nose in the hole. The object of the set is to have a bear reach for the bait through the loop, and that a forefoot is used instead of the bear's mouth (Fig. 20).

Trapping in cold weather should be conducted only when it is absolutely necessary. It is advisable to check your traps as often as possible. Snares will cut off the circulation in a bear's foot, allowing it to freeze. The trap should be set in a site protected from falling and drifting snow. To prevent frost from freezing the snare loop and the spring treadle to the ground, a sheet of wax paper should be laid down under the snare loop and over the hole and treadle. Before covering the loop with dry dirt and pine needles, place another round sheet of wax paper with the center cut out over the snare loop.

Snares should be checked twice a day when possible and more often in areas with human activity. If there is any reason that a snare cannot be checked at least once a day, then it should not be set. Never overextend the trapping program. Extensive trap lines that take most of the day to check are not acceptable. If you catch four bears in one day, for example, you may not get to the last bear until early evening. Snares that can be checked with binoculars from a road or with radio telemetry are easier to check more than once a day than traps set along a backcountry trails. The longer a bear stays in a trap, the greater the chance of causing injury, stress or death.

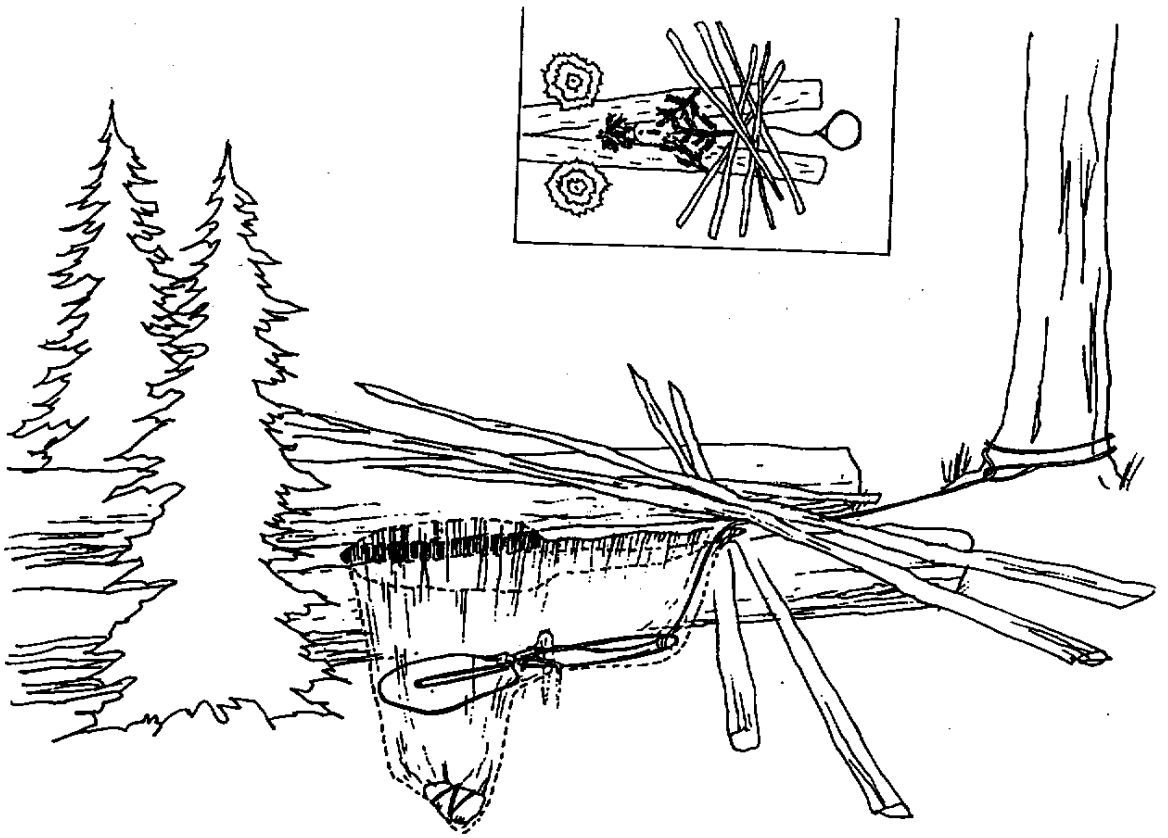

Figure 20. An example of a dip set. Use only as a last resort and with extreme caution. Make every effort to be sure the bear does not reach into the hole with its mouth (drawing by N. Wiegert).

CHECKING CULVERT TRAPS AND SNARES

When checking snares or culvert traps, it is usually best for two armed people to be present, especially when trapping grizzly bears and checking snares on foot. From a distance and before approaching, observe the trap and the surrounding area with binoculars. Some trappers prefer to approach a site with one individual 20-30 yards in the lead, so they can be more alert to any subtle noises or movement. The lead individual should periodically stop and yell in the direction of the snare, and then quietly listen and look for several seconds for any possible movement before proceeding. The person in the rear should always remain alert and silent.

Other trappers prefer approaching the site two abreast. Again, they should periodically stop to shout and carefully listen and look. Bears that have been caught several times are especially prone to laying down without disturbing the site. Don't assume the site will always be torn up and the bear will be visible! Always be on the alert for a protective female or other bear that may be off to the side. Some trappers prefer wearing bright colored clothing so they are more visible to each other when under a forest canopy.

If it looks like a bear is captured, move forward until you have a good view. It is imperative that everyone involved is calm, quiet, alert, and moving slowly. It is best if the bear is unaware of your presence.

Carefully observe the surrounding terrain and look for any movement, sign, or objects that might indicate another bear is at the site. Does the area around the trap look trampled, and are there scats present beyond the snared bear's reach? Estimate the age and the sex of the trapped bear. Is the trapped animal quite vocal and "talking" to another bear? If there is a bear guarding the site or cubs present, see section on dealing with more than one bear (Appendix I).

If the animal is in a culvert trap, look at the bear's silhouette and the sliding door. Is the door completely down and locked shut? Observe the safety lock, door, side windows, and mesh for any damage or broken welds. Is the bear moving any parts of the trap or working on a weak spot?

If the bear is in a snare, be especially careful. Look at the snare loop with binoculars and determine how well the bear is caught. Next, follow the length of the snare and look for damage to the cable, swivel, or anchor. If you can't see the entire snare, move closer and if needed, let the bear know of your presence so it will move its position. If the bear is caught by its toes, the cable is twisted and broken, or the anchor tree is almost chewed off, you may have to act quickly and take special precautions.

Check the animal's paws, legs, and shoulder areas for injury. Is there blood on the logs or ground? Is the bear favoring any limbs? Does it look sick or over-heated? If the bear is ill or severely injured and bleeding, immobilize it and apply first aid

quickly. If the bear is hung up or perched in such a way that a leg could be broken, figure out how to approach it without causing more harm.

Move closer to the bear and get a weight estimate, judge its disposition, double-check to make sure it is not injured, and plan your approach for drugging. If the bear is in a culvert trap, cover both ends with tarps. Next, move off to a staging site and decide on a dosage and method of drug delivery.

DRUGGING BEARS

Preparations for Drugging a Bear

To prevent confusion and stress, only two or three people should be present when drugging a grizzly bear. One competent individual armed with a rifle or shotgun should guard and watch the process. Another person armed with a shotgun can help get the bear's attention and protect the drug deliverer. The third, with a side arm, delivers the drugs.

Before approaching the bear, double-check to make sure the snare or culvert trap is still secure. Learn to trust the trap. If the necessary precautions have been taken, the trap has been properly maintained, and the bear is well secured, there should be little to worry about. Before proceeding, make a note of the best escape routes should another animal appear or should the trapped bear escape.

When possible, there should be no conversation or unnecessary noise such as running engines and slamming doors. Communicate by whispering and hand gestures. Unneeded noise may upset the animal. Try to remain calm and don't react to the bear's sudden movements or show fear. It is important to be patient and move slowly to let the animal get used to your presence before moving forward.

Your voice can be helpful to calm the bear. It's best to be serious and talk with a low and soothing tone. Be aware that emotional states are reflected in speech. Never use harsh pitches. Stand up straight and approach with slow confidence.

The only time eye contact with a bear should be made is when dominance needs to be established while drugging the animal. Direct eye contact is a challenge and might inspire a sudden rush by the bear. If the animal charges, avoid reacting and losing eye contact. When the bear becomes submissive, it will avert its eyes and accept your presence.

As you approach, study the bear's body language and its eyes and listen to its vocalizations to detect signs of fear, stress, rage, or aggressiveness. Bears clearly express their intentions, thus allowing the handler to know when to back off or approach. If the bear is especially aggressive and repeatedly charges, it may have just been captured. It may be best to leave the site for an hour to allow the bear to tire a bit before proceeding with drugging.

The bear should be thoroughly examined to determine a health, age, and weight estimate. While checking out the bear's disposition, decide on a method of drug delivery. If the animal is in a snare, see how close you can get to it. Can you drug it with a blowgun, CO_2 pistol, or jab stick? If the animal's attack response distance is easily overstepped, plan on using a darting rifle.

Avoid handling bears when the temperature is above 90 degrees Fahrenheit (32.2 degrees Centigrade). If the circumstances demand handling, always have at least 5 gallons of water available or a

fresh source nearby. If the temperature is below freezing, the bear should be kept warm.

Estimating a Bear's Weight

There are no surefire methods for estimating bear weights accurately, but one technique used by many trappers is to categorize each captured bear into a weight class. By looking at the animal carefully from different angles, you can make a rough estimate of its age and sex. By then using previous data and knowledge on bear weights in various sex and age classes during different seasons in that region, you can make a fairly accurate estimate on the amount of drug to use (Table 1).

Get as close to the bear as possible and look at it from a level position. When you are looking downhill, an animal will appear small, and larger if you are looking uphill. Also, consider the size of the culvert trap or the size of the logs and anchor tree at the snare set. A smaller bear, for example will appear large if it is silhouetted against pole-sized timber. It is much more difficult to guess the weight of a free-ranging bear.

Table 1. Average grizzly bear weights (in pounds) by sex for the Yellowstone Ecosystem.*

	Females			Males		
Age	Mean	(Spring-Fall) Range	n	Mean	(Spring-Fall) Range	n
Cub	49	13- 68	8	53	13-115	16
1	128	55-170	13	139	100-217	18
2	186	119-269	11	216	150-275	19
3	220	170-265	9	303	220-400	17
4	255	200-349	8	339	200-534	14
5	275	225-355	9	328	225-529	9
6	254	220-279	5	409	325-438	8
7	265	240-300	7	417	350-499	7
8	279	225-400	7	379	350-400	5
9	316	255-400	4	438	300-599	6
10	322	225-427	6	372	215-450	5
11	336	228-425	6	493	320-634	7
12	296	225-350	4	438	375-538	4
13	376	285-420	5	574	549-599	2

* Taken from Blanchard (1986).

Another method for estimating weight is to compare each bear with another animal of known weight. By looking at one of the other crew members and the bear, for example, a person can come up with an approximate weight (Fig. 21). Just remember that the long hair on a bear will probably make it appear larger than it really is.

Al LeCount in his "Black Bear Field Guide" says bears come in two sizes, big and small. By viewing the physical characteristics of the head, one can roughly determine the animal's size. After a year a bear's ears are roughly 5 inches long and remain so throughout life. As a bear grows, however, its head gets bigger and its eyes grow wider apart. A bear that appears to have a long and narrow head and large ears is probably a sub-adult, and a bear with a wide head and small ears is an adult.

All bears steadily gain weight until reaching breeding age. In general, males keep growing until about age eight. Females, once they start reproducing, have tremendous weight fluctuations.

In the fall, most bears are fat and have a lower basal metabolic rate and therefore require a lighter drug dose than leaner spring and summer bears. Fat, which is an inactive non-metabolizing tissue, makes animals appear larger, and thus

Figure 21. A photo of a 65 pound dog and a 270 pound bear. The bear is roughly four times the dog's size (photo by J. Perry).

results in higher drug doses than necessary. However, longer needles are required in the fall to penetrate the fat layer to insure the drug is injected into muscle tissue (Fig. 22).

Estimating the Age and Sex of the Bear

It is difficult to age a bear by sight. Cubs will be quite small and infant-like in appearance and behavior. Young bears are usually curious and unwary and will be playing and moving around in an uncoordinated fashion. Subadult grizzlies vary in body size but will appear gangly, inexperienced, and are often overly timid or bold. Also, like young elk and deer, their faces and ears will appear immature. Adult bears are usually more healthy-looking and have a confident body stance. Very old bears and dominant males are often heavily scarred with torn ears, sagging lower lips, and a pronounced sagittal crest. As a rule, female and subadult grizzlies tend to be lighter colored than adult males.

Bears can be difficult to sex by merely observing their appearance and behavior. Like labrador retrievers, male bears will usually appear blocky and have wider noses, bigger heads,

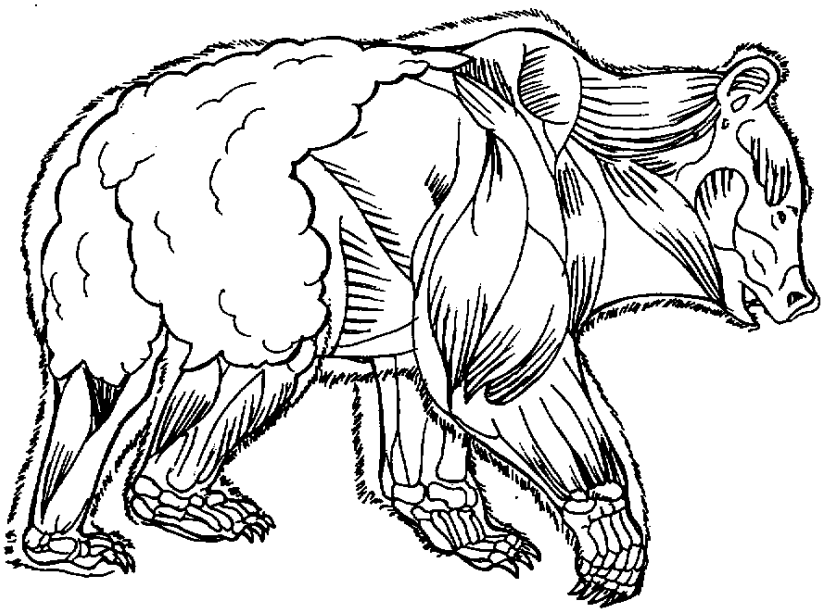

Figure 22. Location of major fat deposits on a bear (drawing by N. Wiegert).

and larger bodies than females. If a good side view is available, a tuft of longer hair may be visible on the abdomen of males at the tip of the penal sheath.

It is important to consider the age of the captured animal. Newborn cubs, for example, have very low basal metabolic rates, but as time goes by the rates increase and peak at puberty. Subadult bears, therefore, will have the most drug tolerance. In a study on dogs, results showed that the adolescent group stayed anesthetized the shortest period of time, and when given repeated injections until death, survived the longest (Lumb 1963). On the other hand, older animals require smaller dosages and tend to stay down longer. Females appear to have a higher metabolic rate and require a slightly higher dose than males.

Evaluating the Health and Disposition of a Bear

After estimating the weight and age of a bear, you should also observe the animal's disposition and general health before deciding on a drug dosage. The nose and eyes should be observed for any discharge, and the pelt should be checked for hair loss. Also estimate the amount of time the animal has been in the trap and determine if it is dehydrated, exhausted, gorged on bait, or suffering from such things as malnutrition, heat exhaustion, hypothermia, or infected wounds.

The success of a drugging procedure depends a great deal on an animal's condition. In general, bears are very tough and healthy and exhibit incredible abilities to heal. A bear suffering from an injury, illness, or a massive infection, however, could die as a result of drugging. When a bear's trapping history is available, the records should be examined for any allergic reactions. Also, some bears have a high tolerance for certain drugs.

As a rule, the higher an animal's basal metabolic rate, the higher the drug dosage needed to cause anesthesia. Metabolic rates vary considerably from individual to individual and also seasonally. Bears generally require a higher dose in mid-summer than other times of the year. A bear's mental status can alter the effects of anesthesia. Bears suffering from shock need smaller dosages because they have a lower metabolic rate. At the same time, responses to the drug will be delayed because of poor circulation (Lumb 1963).

An animal exhibiting signs of stress, fear, hostility, or any form of hyperactivity will require a larger drug dose than a mild-mannered bear. A trapper dealing with an irate female grizzly, for example, could avoid multiple dosing if the original injection is larger than normal.

When it can be avoided, females with young cubs should not be immobilized. Apart from the ethical considerations, these animals are already having a tough enough time finding food and coping with day to day life. Females with cubs usually require a slightly larger dose. Some drug residues will be passed through to nursing

cubs.

Any bears that appear to be suffering from disease, infection, or malnutrition should be given a smaller than normal dose. If it appears the bear has just finished devouring a sizeable portion of bait, be aware that regurgitation under anesthesia is always a possibility, especially when Rompun is used.

Unlike many animals, bears are usually able to express emotional states such as fear. In fact, bears release the same neurochemicals as humans when terrified (Fox and Weintraub 1991). Whenever a bear is unable to flee or fight (the alternatives available for every other type of situation), it will be under stress. Extra care must be taken to limit unneeded stressors such as too much talking and movement by the handlers. If possible, any animal exhibiting terror, panic, or uncontrollable shaking should be left alone. The animal may injure itself or it could die from fatal adrenal shock if subjected to a restraint procedure that overtaxes its body reserves. When possible, these types of bears should be allowed to calm before drugging. A higher than normal drug dose is recommended if the animal must be drugged.

Deciding on a Dosage

First, determine what the dosage would be according to the bear's weight. Then, considering the time of year, the bear's condition, and the situation at hand, decide if it should be overdosed or underdosed. Pearson et al. (1968) in their work with grizzly and black bears decided that the optimal dosage was the minimum amount at which the animal could be handled for the required time. This depends largely on what data is to be collected. For a thorough handling procedure, IGBST crew members require approximately 75 minutes when handling a grizzly. In this time the bear is measured, instrumented with a radio collar, and ear tagged. In addition, a tooth is taken for aging and blood and tissue samples are collected. In dangerous situations, it is advisable to use a heavier dose for reasons of safety. In order to avoid multiple injections, it is better to use a slightly higher than recommended dose than a lower one.

Evaluating the Best Target Areas on Bears

The person who delivers the drug should be relaxed, confident and experienced. Never let someone pressure you to hurry up a process or to make a decision that has not been thought out properly. Even though precious time should not be wasted, it is important to be patient and wait for the bear to make the right move before firing off a dart.

Never dart a bear with an unfamiliar gun. If you are worried about your skill, let someone else drug the bear. An unfamiliar dart gun or a gun with questionable accuracy should be sighted in before darting. Load up a practice dart with water to sight in the

gun. The process only takes a half hour, and is better in the long run, even for animals waiting in a trap.

A Palmer rifle, armed with a red or sometimes yellow charge, can easily imbed a dart into the hind quarter of a bear. Always use the lower-powered brown or green charges in the Palmer rifle. Darts fired from CO_2 powered guns have also been known to imbed in bears and should not be used at high velocity at close range.

As a rule, never shoot a darting rifle over 30 yards or a pistol over 10 yards. Whenever possible, wait for a close shot rather than taking a long one. The management/research endeavor is never worth the death of a bear. Keep in mind that strong wind, cold and heat can affect dart flight and mechanics.

Subadult and adult bears are usually not difficult to drug if care is taken. Determine the best target areas by considering the animal's body mass and condition. Cubs, yearlings, and emaciated bears are more difficult to drug because the target area is small and the chance of a misplaced dart is high. When possible, they should not be handled, and they should definitely not be darted from a distance. The decision to free-dart a cub should be a last resort with the understanding there is a very high risk of mortality.

Fall and spring bears, especially adult males, can have fat deposits up to five inches thick over the hind quarters. When drugging a fat bear, you should aim for the neck or front shoulder. If you have to drug it in the hind quarter, be sure to use a long needle. It should be noted again that an injection of drugs into a fat layer will have no immediate effect on an animal.

Drug absorption from intramuscular injections are unpredictable when compared with intravenous injections. Absorption rates will vary depending on the muscle's state of hydration and lactic acid levels (Harthoorn 1965). Intravenous injections are impossible to prevent, however, unless the animal is already immobilized.

Aim for the center of big muscles that can drain infections and be licked by the bear. The muscle group boundaries should be visible and bunched when shooting. The center portion of a bear's hindquarter is an excellent target. Be aware, however, that if you shoot too high, the needle could imbed in the bone and cartilage around the hip or strike the back bone. If you shoot too far to either side of the thigh you could hit the genitals, the anal canal, the femoral triangle or paunch.

The neck is also a fair target, with the drawback that the bear will not be able to lick the site. Grizzly bears will often face the person with the capture gun, and the neck is the only target available. Aim for the heavy muscle at the top of the neck near the shoulder to avoid hitting the jugular vein, carotid arteries and wind pipe on the underside of the neck. Always use a short needle when trying a neck shot to avoid hitting bone. Wait until the animal looks away before shooting to minimize the chance of hitting it in the eyes. If the animal is young or skinny, wait for a hindquarter shot.

The upper meaty portion of the front leg is also a good target. If the shot is made too high on the shoulder, the dart could imbed in the scapula, and the bear will have trouble cleaning the wound. If the bear is hit in the rib area, the dart could strike the lungs or enter the body cavity (Fig. 23).

Never shoot at a moving bear and always consider the angle at which a dart will strike a given target. Wait until the animal has stopped and the body is well defined. When possible, you want the dart to impact the muscle straight on. A level ground shot should always be chosen over a downward or upward shot. When shooting on a flat trajectory, there is a larger target area and less chance of a poor shot. When shooting down on an animal, aim for the lower muscle groups to avoid hitting the spine. Aim for the upper muscles when shooting upward to avoid entering the underside of the body. This way if the target is missed, there is less chance of causing injury.

When possible, wait for a broadside shot and avoid shooting bears standing at an angle. The side profile position offers a larger target area with more muscle mass. It also limits the chance of having a dart angle into a vital zone.

If the bear is quartering toward you, you may want to aim for the shoulder or neck. Be sure to aim at the front of the shoulder muscles to compensate for the angle. You don't want to glance the back of the big muscles and send the dart into the rib or paunch area. If you aim for the hindquarter, shoot toward the rear of the muscle to avoid hitting the inside of the other thigh and femoral triangle. Never attempt to dart a bear facing directly toward you.

Any dart that enters the body cavity and damages vital organs may cause death. If you can't see exactly where the dart made contact and the bear is showing symptoms from the drug, make a note of your target area. As soon as the bear is immobile, see if the dart bounced out onto the ground and then search for a dart wound. (See Appendix I if dart enters body cavity.)

Drug and Dart Preparation

Once you have determined the bear's weight and agreed on a drug mixture and dosage, leave the animal and take your drugging and handling equipment to a preparation site that is not visible to the bear.

While drugging any animal, you should take every precaution to prevent an accidental human injection. Bear handlers should also strive to keep the process sanitary. Precious time, however, should not be wasted by being overly zealous about sterile procedure and safety. At the same time, many of the common drugging practices followed by bear managers and researchers in the field today are unsterile. Sterile procedure and drug safety in the field should be effective, yet uncomplicated.

When handling drugs, all crew members should be familiar with safe drugging procedures. To avoid confusion, only one person

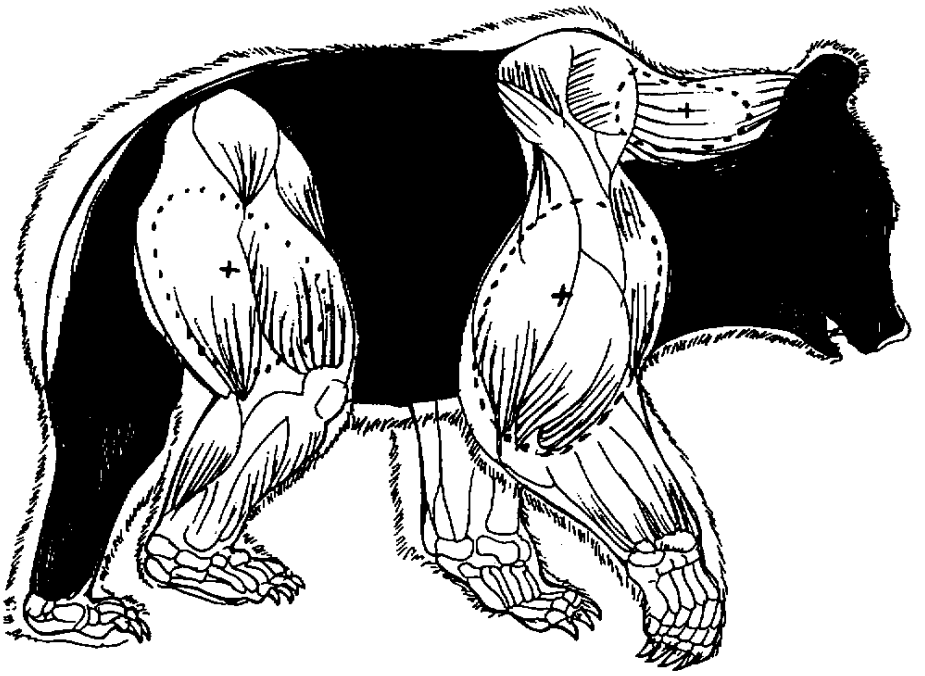

Figure 23. Preferred target areas for drugging a bear (drawing by N. Wiegert).

should handle and administer the drug. All used syringes, needles, dirty gloves, and empty drug bottles need to be kept in a hard-sided container until they can be later sent to a medical lab for disposal.

To avoid contact with the skin, it is a good idea to wear rubber gloves when handling drugs. Also, syringes and drug vials should never be stored in pockets. All loaded needles should be capped until the drug is administered. (See Appendix I, Treating Human Exposure to Drugs.)

The wearing of rubber gloves also minimizes the contamination of instruments. All darting needles, plungers and cylinders should be boiled or autoclaved beforehand and stored in airtight plastic containers or ziplock plastic bags. Before using in the field, dart components can be soaked in a cold sterilizing solution such as Nolvasan for 10 minutes. Hydrogen peroxide and alcohol, which are commonly used by some researchers and managers, are not antiseptic washes and have little effect on bacteria. When using cold sterillants other than Nolvasan, always rinse with sterile water and a syringe after soaking. Capture needles and cylinders should not be stored in a bottle filled with a sterilizing solution, or else the aluminum will oxidize and erode.

It is recommended that different syringes be used for drawing the drug, tranquilizer, and sterile saline solution to prevent inadvertent mixing. Disposable sterile syringes and needles should only be used once. Never put a needle back into a vial after injecting a drug into an animal. The used projectile darts should

be taken apart and cleaned in warm water and then sterilized as soon as possible.

It is important to carefully monitor your drug supply. Do not use expired or contaminated drugs. The seal of each drug vial should be checked for cracks and leakage. Any drugs containing particulate matter should not be used.

Powdered drug mixtures like Telazol and higher concentrations of Ketamine/Rompun should be hydrated with sterile isotonic water to the desired concentration. The mixture should be agitated until it is thoroughly mixed. In colder weather the mixture may have to be warmed before it will go into solution. The vial can be placed over a defrost vent in a vehicle or heated by body temperature. Be aware that heated drug vials will be under pressure.

When drawing the drugs out of the vial with a syringe, make sure there are no air bubbles and that the calculated dose is measured exactly. Air pockets can be removed by holding the syringe upright and tapping the side. Avoid injecting any air into a bear as it could cause harm. Use a 20 gauge needle to draw drugs and add water to vials. Larger gauge needles put large holes in vial seals, causing them to leak. Equalize the pressure in the drug vial by injecting the same amount of air into the vial as the liquid volume which is being removed.

Preparing Cap-Chur Darts

Select a Cap-Chur dart cylinder, needle, and plunger from the drug kit and place them in a container with a sterile solution. The plunger should not be old or cracked, and the dart cylinder size should correspond to the bear's dosage (Fig. 24). The dart needle style and size depends on the drug handler's preference, the handling situation, and the individual bear.

Barbed 3/4 inch needles are usually long enough for most applications. Most trappers prefer barbed needles with the barbs shortened, thus allowing the dart to be easily pulled out by the bear after impact or later by the handler without having to cut the hide. Collared needles have resulted in incomplete injection of the drug when they are pushed back out of the muscle by the action of the internal capture charge. They can sometimes be forced out by the internal charge with such force as to be a danger to the handler. When drugging bears with a Cap-Chur jab stick, use a smooth needle (Fig. 25). Longer needles can be used on larger, fatter bears. A cracked or old rubber O-ring on a needle may allow leakage. Keep the Cap-Chur needles sharp so they will readily pierce the bear's hide.

Remove the cylinder, needle, and plunger from the sterile solution and rinse with sterile water. No rinsing is necessary if using Nolvasan. Lube the sides of the plunger with sterile petroleum jelly and insert into one end of the dart cylinder. Push the plunger back and forth in the dart cylinder with a clean positioning rod to lube the inside of the cylinder. Stop with the

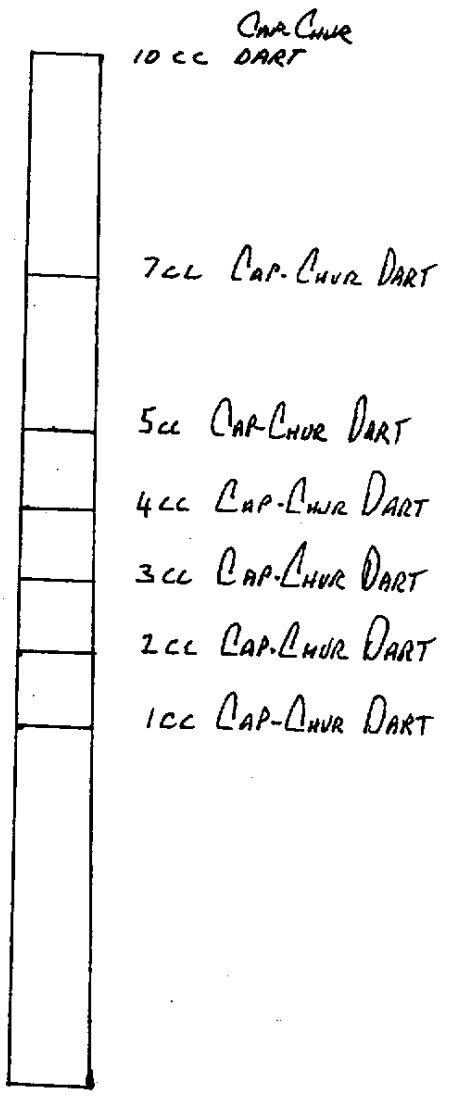

Figure 24. Barrel sizes for Cap-Chur darts (drawn to actual size).

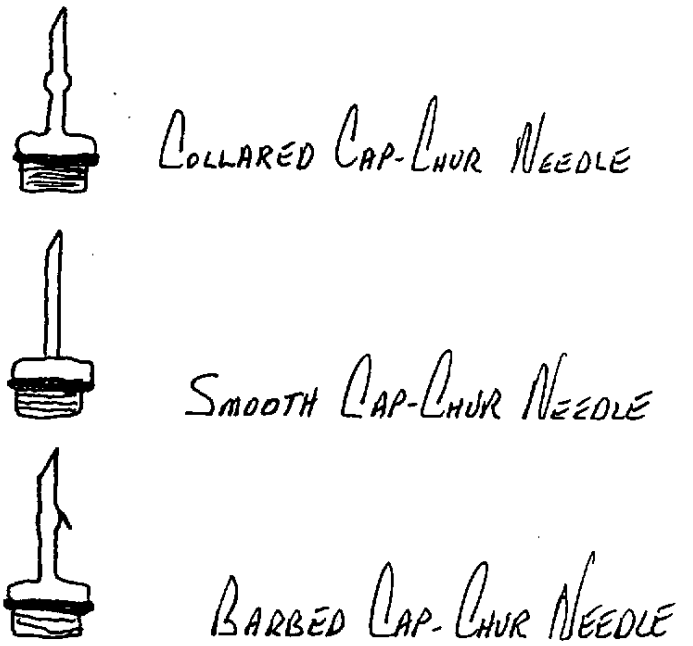

Figure 25. Three styles of Cap-Chur needles.

open end of the plunger flush against one end of the cylinder. If the bear is to be drugged with a Cap-Chur jab stick, the plunger and cylinder can now be placed onto the jab stick. (See preparing a Cap-Chur jab stick.)

If the dart is being prepared for a dart gun, it will require an internal Cap-Chur charge and tail piece. The appropriate internal charge (1-3 cc or 4-10 cc) should be chosen, placed with the solid end inside the plunger, and pushed down until the top of the charge is level with the rim of the barrel (Fig. 26). (WARNING! If the internal charge is placed in the dart backward, the drug will be expelled from the dart upon firing.) Any damp or dented charges should be discarded.

The tail of the dart should then be screwed on tightly against the charge. The dart tail piece should be undamaged and of a bright color. Plastic dart tails are more accurate and should be used for longer-range shots. The yarn tail pieces should be clean, dry, and symmetrical for best flight trajectory. Any worn out or damaged tails may not be accurate and should be discarded. The O-ring washer on the tail should be in good shape so as to form a seal (Fig. 27). Add the drug mixture to the upright dart with a hand syringe. If the drugs do not reach the fourth thread of the cylinder, add sterile water. An alternative to adding sterile saline is to push the charge and plunger forward with a glass positioning rod until the fourth thread is reached. Be aware that

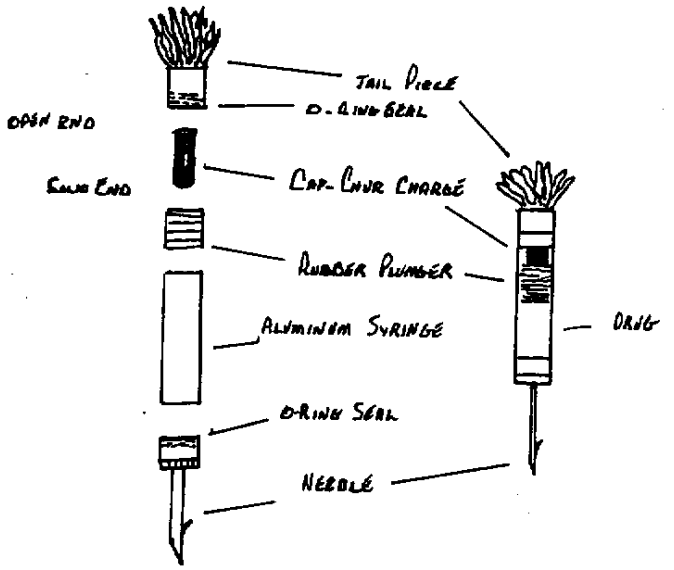

Figure 26. Cap-Chur dart assembly.

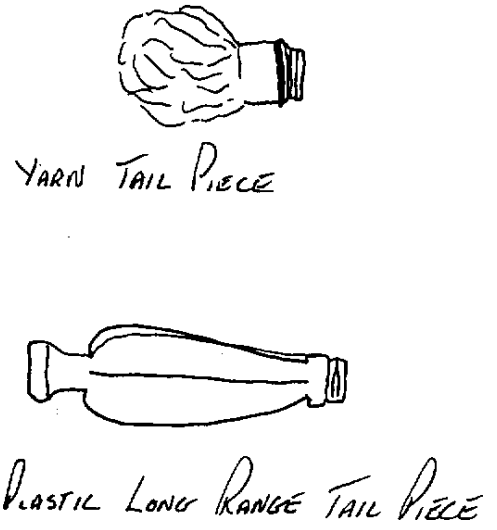

Figure 27. Cap-Chur dart tail styles.

partially filled darts are not balanced and that the dart could tumble when longer shots are taken. Tap against the side of the cylinder with a glass positioning rod to remove any air bubbles that may be present. When you screw on the dart needle, a bead of liquid should form at the tip of the needle. If not, carefully push the plunger forward with the glass positioner until liquid is visible on the needle's point. Place a dab of sterile jell on the needle tip to keep dirt out. In cold weather the dart should be kept warm. The dart is now ready to be placed in the Cap-Chur rifle or pistol.

Preparing Blow Gun Darts

Look the blow dart over carefully for any damage. If the plungers appear to be old or the tail piece has visible holes, throw it away and pick out a newer dart. When sterilizing the blow dart it is important to keep the yarn tail piece dry. With a syringe, inject cold sterilizing solution into the dart's drug chamber and then force the internal plunger up and down the tube. This will sterilize the chamber and lubricate the plunger at the same time. The internal plunger can be moved up and down by inserting air with a large syringe with a 20-gauge needle through the rubber of the dart's tail piece into the pressure chamber. Using suction and pressure from the syringe, move the plunger. Stop the plunger at the appropriate level with the sterile solution removed. The size of the drug chamber will depend on the amount of drug needed to dose the bear.

The drug is drawn into a separate syringe and injected through the tip of the dart and into the drug compartment. Make sure there are no air pockets in the dart. Place a sterilized 1 1/2-inch 20-gauge blow dart needle on the dart and push the internal plunger forward until the drug squeezes out the needle hole. Seal the dart by pushing a sterilized sleeve over the needle's hole. Pressurize the dart by injecting either a drop of butane through the dart's tail piece or with several cc's of air.

The technique for adding butane is simple. The canister should be shaken and then fitted with a 20-gauge needle. Angle the canister downward, holding the needle on with your index and middle fingers. With your other hand, bring the dart up and insert the needle through the tailpiece. With one quick motion, press the butane canister needle downward and pull the dart off the needle simultaneously. It only takes a split second to put a small ring of liquid butane in the pressure compartment. If too much butane is present, some can be released by inserting a needle through the tailpiece. Bubbling of the liquid indicates a poor seal and a new dart should be used. Never insert anything larger than a 20-gauge needle through the rubber tail piece or the seal will be lost.

In cold weather, the dart's butane or air charge must be kept warm. The dart can be prepared and then placed in a hard container and stored in a pocket, or the dart can be charged just prior to

shooting. Be careful not to bump or overheat the blow dart, as it could activate the plunger and cause the drug to eject prematurely. The dart should then be placed in the blow or dart gun (see Appendix II for more detailed instructions and illustrations).

Preparing the Drug Delivery Devices

Dart Guns

The pistol or rifle should be clean and free of rust and powder fouling. The rifling inside the barrel should not be pitted. If needed, clean the gun's barrel with a copper brush and bore cleaner, as any buildup will affect the dart's trajectory. CO_2-powered dart guns should first be test-fired. Cock the gun at both power levels and fire twice into the ground to check out the pressure of the low and high power settings. If the CO_2 cartridge seems weak, replace it. If there is no pressure at all, the the gun's CO_2 cartridge chamber may need a new seal. Remember, the efficiency of the CO_2 cartridge will correspond to the temperature. On warm days the gas will expand and the power of the gun will increase. During cold weather the CO_2 charge will have to be kept warm for maximum efficiency. Air guns are powered by compressed air. The power of the rifle corresponds to the number of times the firing chamber is pumped.

With Palmer rifles, it is very important that the barrel and .22 adapter be cleaned after every shot to maintain accuracy. Left uncleaned, the rifle will noticeably shoot progressively worse because of unburned powder build-up in the barrel and poor gas exchange in the adapter. The adapter should be taken apart and the cardboard wads removed after every use. It's a good idea to include an extra adapter or two with the rifle. It is recommended that only green and brown .22 charges be used. Red powder charges are too powerful and should <u>never</u> be used!

If the dart gun is in satisfactory condition, insert the dart into the breech. Push the dart further into the gun barrel with a glass positioning rod. The depth to which the dart is placed down the barrel corresponds to the distance you are firing. By increasing the size of the gas firing chamber, you decrease the dart velocity. The closer the target, the less power you will need and the further down the barrel the dart should be positioned. For extremely close shots, the dart should be pushed down the barrel until the needle is almost visible. The gun should not be cocked or armed until you are ready to dart the bear.

Blow Gun

Connect the blow gun's segments together after making sure the tubes are clean. Before loading the dart, you may want to take

several shots with a practice dart. When ready, insert the loaded dart into the tube, needle first, and approach the bear. Be careful not to bump the blow gun and set the dart off.

Jab Stick and Syringe Stick

If the Cap-Chur jab stick device is not already on a pole, find a suitable stick and tape it on securely. The pole should be at least six feet long. When the Cap-Chur dart parts have been sterilized, the lubricated plunger can be placed on the jab stick's hub and the dart cylinder can be put onto the assembly. Add the drugs and screw on a smooth-stemmed needle. (See section on preparing a Cap-Chur dart.) Be careful not to contaminate the needle or lose the drug.

If using a syringe stick, select a new syringe and 20 ga. needle and tape it to a pole. Stick the syringe stick needle into the drug vial and draw out the desired amount of drug. Remove any air pockets in the syringe and then cover the needle. Be careful not to bump the pole or syringe (see section on constructing jab sticks and syringe sticks).

Drugging Bears in Culvert Traps

Approach the trap quietly from the side and avoid placing your silhouette at the opening. If tarps were placed over the ends, remove them. Peer in and check out the bear's disposition. Don't react to attacks, and wait for the animal to accept your presence. Let your eyes adjust to the darkness and look for a good target.

It is best to wait until the bear relaxes. Eventually, because of sore muscles or a distraction, the bear will turn or shift its weight and offer a good muscle mass. Occasionally, a recaptured or wary bear will make positioning difficult.

To shift the bear's position, have another person be the aggressor. Remain motionless and observe. The bear will eventually accept your presence and key into the actions and movements of the other person. The aggressor can tap, scratch or kick the side of the trap. Only as a last resort should the animal be poked.

When delivering the drug, make sure no one is standing at the opposite end of the trap in case the dart ricochets. It is not advisable to open the side doors unless light is needed or the drug delivery device won't fit through the mesh or peep holes. A CO_2 or air pistol are perhaps the best delivery systems for a bear in a culvert trap. Blowguns are also good, but extreme care should be taken to avoid sticking the far end of the blowgun into the culvert trap. One quick swat by a bear against the tip of the blowgun could severely injure the handler. Jab sticks can also be used on bears in culvert traps, but present more of a problem because of restricted maneuverability. Hand-syringing is impossible unless the

bear has its body pressed against the side of the mesh or a drain hole, and it doesn't respond to touching or movement. Cap-chur rifles should be armed with the lowest charge (brown), and the dart should be positioned almost to the very end of the barrel. The bear should be at the other end of the trap when the rifle is fired. Even with these precautions, there is a chance of making a bad shot.

Drugging Bears in Snares

On many wildlife research projects, a Palmer Rifle is the only method used for immobilization. Rifle-darting keeps the process simple and reduces stress. It becomes a necessity when a bear is very distressed, captured by a toe, or on a snare with a threadbare cable. When in doubt of the safety of the situation, dart the animal with a rifle.

Because of the larger size and more aggressive nature of most grizzly bears, Cap-Chur rifles are used almost exclusively. For small or young grizzlies and almost all black bears, an alternate drug delivery system is preferred.

Sneak forward until there is a clear shot with a rest, and wait behind cover for the ideal target. It is best if the bear is unaware of your presence. Determine how well the bear is caught and the bear's disposition. If the snare loop is loose, the bear is poorly caught, or the cable is frayed, drug it from a distance. Otherwise, approach to within 15 yards. If the snare is working properly and the bear is not agitated, don't be afraid to approach even closer. Look at the site around the bear, and note the radius of the cable and the area the bear has reached to rip up soil and logs. **Never** step into this zone and make yourself available to the bear!

When darting grizzly bears, the armed back-up person should be behind the person doing the darting and slightly off to the right. Upon being darted, snared grizzlies will usually make a head-long rush at the handlers. Should the cable break, the back-up should be ready to fire. The individual with the Cap-Chur gun should immediately exit to the left and then back after shooting, while the other stands guard for several seconds before leaving. Back off to a point where the bear can still be observed but is not excited by your presence.

When darting a snared bear with a pistol, cock the pistol and approach the bear slowly and carefully to within 15 feet. For most darting situations, use the lower setting. Extend your firing arm and rest it, if possible, on a branch or log. Be patient, let the bear get used to you, and fire when the bear offers a good shot.

When darting a snared bear with a blow gun, get as close as possible, have a steady rest, and aim for a big muscle. Be prepared to pull away if the bear swats. Take a good mouthful of air, place your mouth tightly over the mouthpiece, and blow. An insufficient breath might mess up your aim or the necessary impact needed to push the drug out of the dart. A poor shot in the ribs or stomach

is not as devastating as a dart fired from a gun. Note where the dart hits (Fig. 28).

When drugging a snared bear with a jab stick, find the safest approach, and herd the bear in such a way that it wraps itself around a tree or log and is unable to attack head-on or run the length of the cable. The more awkward the animal's position the better. The muscles then become bunched to provide a good target, and the bear won't be able to react as quickly. Nevertheless, have a clear escape route. Approach the bear and wait for a good target, and then jab with a straightforward, steady thrust.

Drugging a snared bear with a syringe stick is not as difficult as it appears. After the bear is wrapped around the tree, approach the bear at an angle that makes swatting and biting difficult. Stand quietly until the animal accepts your nearness. Gently touch the bear several times with the other end of the syringe stick. The bear will eventually accept the sensation. If the bear is too aggressive, switch to another method.

Reverse the stick, remove the needle cover, and move the syringe slowly toward the bear. Be prepared to pull back if the bear makes any sudden moves. Pick a muscle, and slowly and firmly insert the needle to the hub and apply pressure. The bear may react to the pain and attempt to move away. Watch the injection site to make sure no drug squeezes out on the hide. Don't jab or jerk the needle, or it might break under the skin.

Drugging Free-Ranging Bears

Precautions

Darting free-ranging bears from the ground is difficult and chancy--but always tempting. Free-darting should always be avoided unless there are no other options, which is rarely the case. Too many bears have been shot from too great a distance. Some have been struck in the abdominal cavity, and others have run off into thick timber where they become immobilized, but are not discovered by the handlers. Also, it is extremely risky for handlers to follow a darted bear into thick cover. However, in certain management situations, free-darting may be the only alternative.

When darting a free-ranging bear, use a fast acting drug like Telazol, and administer a higher than normal dose. The animal should be made immobile as quickly as possible. Also, one or two extra darts should be prepared in case you miss with the first shot. The tails of the darts should be a bright neon color and the darts should be polished, so they can be seen sticking in the bear or lying on the ground after shooting. Use a barbed needle when you dart a free-ranging bear with a transmitter dart or a dart with a tracking string attached to it. Once again, be proficient with the rifle and use a low pressure dart charge. When shooting at longer distances, use a darting rifle with a scope and know the range of

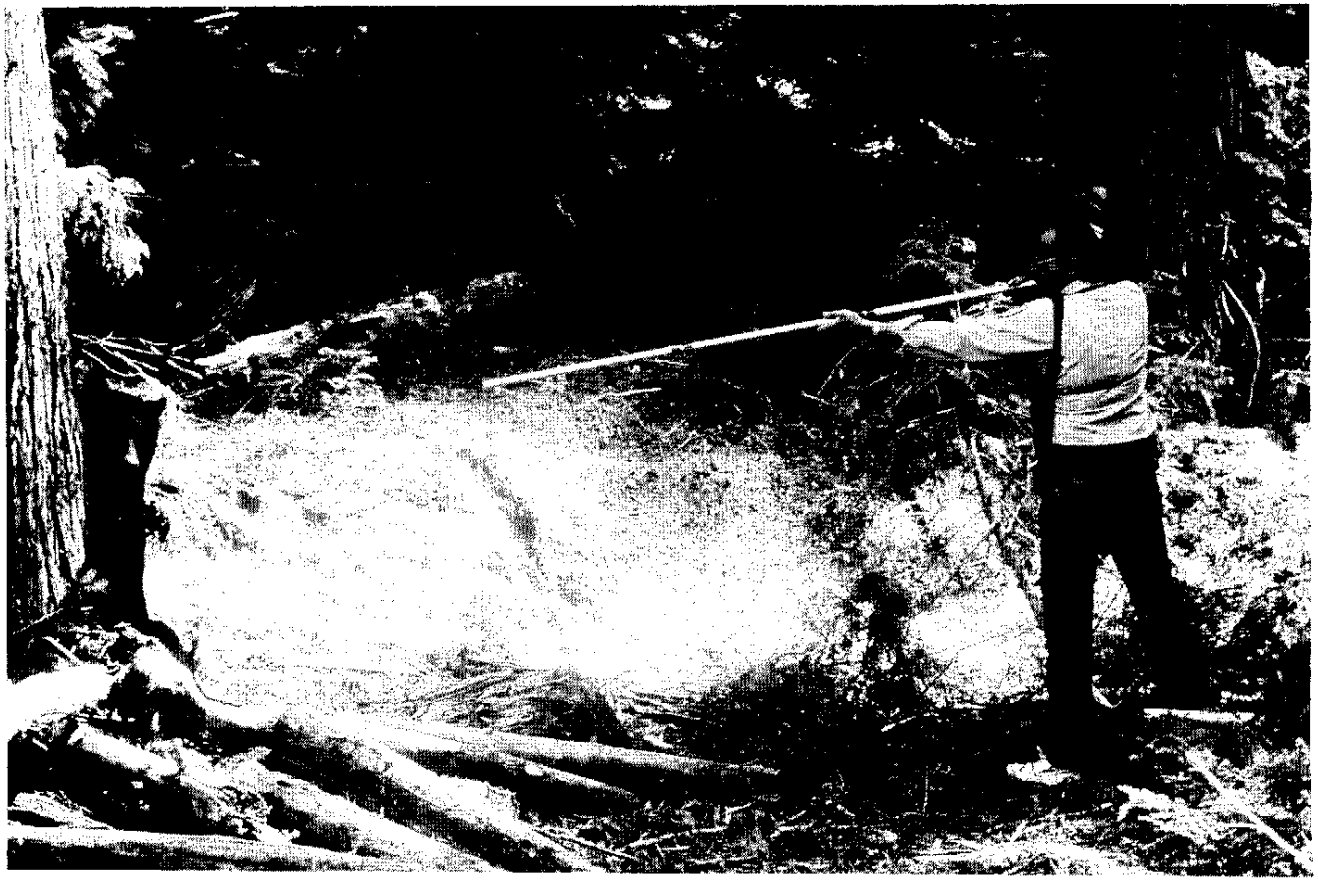

Figure 28. Darting a bear with a blowgun. Note how the bear is wrapped around the tree and unable to move (photo by M. Burcham).

your rifle.

Make note of the surrounding terrain. Will the darted bear be able to reach a body of water or cliff area before it becomes immobile? You don't want the bear to drown or fall to its death. Could the animal reach an area where people are observing the capture attempt. If so, be prepared to herd the bear toward a safe escape route. When a bear does reach a body of water and is in danger of drowning, go to its rescue. When the bear loses its motor control, wade out and hold its head above the water before the drug takes full effect. Be aware that a half-drugged bear can still be very dangerous.

When dealing with a bear in an urban area, you must enforce crowd control. When possible, free-dart the animal in the early morning hours or at a site people rarely frequent.

Never dart a bear at a distance you are not comfortable with. The closer the bear is to you, the less chance there is of a misplaced dart. Never make yourself vulnerable to an attack. Always have an escape route planned and free-dart from a protected place.

Free-Darting Bears From the Ground

The ability to free-dart a bear safely depends a great deal on the terrain and foliage at the site. In certain bear habitats it is nearly impossible to get close to a free-ranging bear without taking a risk.

It is much easier to free-dart a bear when it is unaware of your presence. When possible, push the bear away and lay in wait for its return. Never make yourself vulnerable to a possible charge! If there is no safe way to approach the bear, then try to lure it toward another site.

When the terrain permits, the bear should be approached from a vehicle with only the driver and the individual doing the drugging inside. A vehicle with a sun-roof or four windows is best. Drive next to the site where the animal is feeding or guarding another bear, and wait for it to get used to the vehicle. If the bear leaves, wait patiently for its return. When dealing with an aggressive bear that is guarding another bear, be prepared to drive off immediately. Always keep the windows rolled up until ready to dart.

A culvert trap can also be safely used to free-dart a bear, especially for bears that have learned not to go in them. Place a person inside the trap with a hand-held radio, food, warm clothing, a firearm, and a dart gun. Position the trap near the food source or other attractant. If necessary, place some bait about 15 feet from the rear of the culvert trap. Bears can also be lured to the site by using a predator call or mimicking the bawling of a cub.

After shooting the bear, remain quiet and attempt to keep track of its movements. With luck, the bear will stay close to the site. Don't encourage the bear to run off, but watch it in case it gets into a predicament. If the animal does run off, mark the spot

where it was last seen and begin preparations to track it down.

If you missed the bear with the first dart, make a note of the dart's location. Load another dart and wait for another chance. If the bear leaves the area, retrieve the first dart to make sure you didn't hit the animal. Look at the dart and see if the bear received the drug. If you didn't see the dart hit the bear and you can't find it, assume the bear was hit.

Give the drug at least 15 minutes to act before looking for the bear. Only two to three people should look for a free-darted bear. Everyone should be armed and ready in case the bear is not under the effects of the drug. Keep your eyes open and move forward slowly.

If you don't know the bear's location, go to the site where the bear was standing when you shot and look for blood or hair, which might indicate an imbedded dart. Track the bear to the place it was last observed, paying attention to the crushed vegetation and disturbances made in the soil or snow by the bear. Be careful not to walk where the bear walked in case you have to come back to a site and track the animal. One person should ground-track while the other(s) stand guard and look ahead for the bear. Be especially careful when tracking a bear through dense timber or underbrush.

Radio-collared bears are much easier and safer to approach after free-darting. The movement of the animal can be monitored by the direction of travel and mode changes. When the transmitter has a steady, clear beat, indicating the animal is motionless, the bear can be carefully approached. The receiver should be monitored at all times as you approach so the exact location of the drugged bear is known. If there are any mode changes, it means the bear is still mobile. You know the bear is extremely close (< 100 feet) when you can pick the signal up on the receiver without the antenna or coax cable attached.

Telonics, Pax-Arms, and Wildlife Materials manufacture darts with a built-in transmitter specifically designed for tracking free-ranging animals. Although useful, they are expensive, inaccurate, and delicate. A simpler, less-expensive method for tracking darted animals is to use a tracking string. A string tracking unit for archery hunting can be taped to the bottom of the rifle barrel, and the string can be tied to a rubber O-ring from a dart needle and placed in the mouth of the rifle barrel. When the dart is fired, the needle on the dart catches the O-ring and the tracking string is carried away with the dart. The tracking string does not appear to hinder the dart's trajectory. Tracking string units are designed to hold up to a half-mile of 17 pound test nylon line. Be sure to keep the rifle up so the string can pull out freely as the bear moves. When the string stops moving, the bear can be tracked down (Fig. 29).

Free-Darting Bears by Helicopter

In many regions of Alaska and Canada, darting bears from

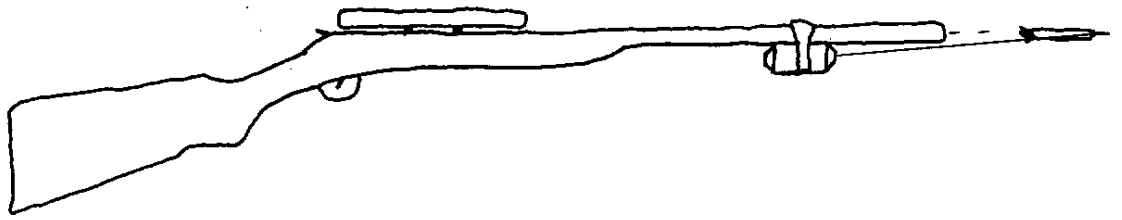

Figure 29. A Palmer rifle equipped with a string-tracker.

helicopters is the only method used. It allows researchers to capture and handle large numbers of bears in a short period of time. Darting bears from a helicopter can be dangerous for the bear and the people involved. Great care must be taken to pay attention to the safety precautions required for helicopter travel and free-darting; there is no room for a mistake (see Appendix VI for helicopter safety).

In order to dart bears from helicopters, the terrain must be suitable. The location should be relatively flat, open, and free of power lines and other obstacles. Strong crosswinds and rocky terrain are dangers that should be considered.

The pilot is in charge of flying and should make all the decisions on how to maneuver the chopper and the bear into a good position for free-darting. If either the pilot or biologist believe the terrain or conditions are too dangerous, stop the darting attempt. The biologist is in charge of the drugging episode and the welfare of the bear. If the animal becomes stressed or overheated, then he or she should stop the process.

Before attempting to free-dart a bear, fly over the whole study area with the pilot and become familiar with the hazards. The pilot should understand how the air currents flow up drainages and across plateaus. When possible, practice the darting routine on elk, deer or caribou.

When a bear has been sighted, the area surrounding the animal should be circled with the helicopter, and any bodies of water, cliffs or danger zones for the bear should be noted. It is imperative that the animal be herded in a safe direction before

darting. Once the bear is encouraged to flee toward a certain route, ease back and wait until the animal reaches a long, open, flat stretch of ground.

Never run the bear too long with the helicopter. The animal should be darted before it becomes overheated or exhausted. If the bear's welfare becomes questionable or if the terrain is inappropriate, call the drugging attempt off.

Once the bear reaches an open zone, the pilot should ease the chopper in to about 20 feet just behind and next to the animal. The closer you are, the better. The drug-deliverer can then take aim and fire at the rump. Once again, it is important that the rifle is accurate and fired with a low pressure charge. Always wait for the perfect shot.

As soon as the bear is darted, back off and monitor the bear's reaction to the drug and wait for it to become immobile before landing and shutting the chopper down. Be prepared to haze the animal away from water and rough terrain.

Drugging Bears in Trees

Drugging a bear that is perched in a tree or telephone pole is a very tricky and dangerous process and should only be done when absolutely necessary. Great care must be taken to prevent the animal from falling after it has been drugged. Just as the bear starts to go under the drug's effect, someone equipped with climbing spurs must climb up and secure the animal. Then once the bear is tractable, lower it to the ground. If the tree does not have a suitable amount of branches for climbing or if climbing spurs are unavailable, do not attempt darting the bear.

A lighter than normal drug dosage is recommended, thus slowing the induction period and allowing the drug-handler time to climb the tree and the bear to hold on to the tree for a longer period of time. Because of its slower induction time, straight ketamine is often preferred, especially on smaller animals. Once the animal is on the ground, more drug can be administered.

Bears are extremely tough and have been known to fall from great heights without injury. A bear's body is very compact and has the ability to absorb more impact than most animals. Even so, every effort should be made to prevent a bear from falling.

Before attempting to drug a bear in a tree, determine if the bear really needs to be drugged and handled. It might be easier and less dangerous to just leave the animal alone. Also, consider the possibility of setting snares around the base of the tree. If the animal eventually climbs down, it might be captured. It is much easier to drug a bear in a snare then when it is 30 feet off the ground.

A person can either free-dart the bear from the ground or climb to just below the animal and drug it with a syringe stick, jab stick or CO_2 pistol. When the animal has climbed a tree or telephone pole in a residential area, a boom truck with a

hydraulically-controlled bucket can be brought to the site. The drug-handler can then maneuver the bucket and himself into a position to drug the animal. When the bear begins showing signs of anesthesia, the bucket can be brought in closer, and the animal can be secured by a hind foot to the tree or pole. If the bear is up a power pole, have the power company turn off all power to that neighborhood until the bear is safely on the ground.

When the animal becomes groggy from the drug, one individual should be prepared to climb up and secure the bear with a rope to a branch or the trunk to prevent it from falling to the ground. When secured, the bear can be given an additional dose if necessary. Don't position yourself directly under the animal in case it falls. Once the animal is immobile, it can be secured by one hind foot and gently lowered to the ground with the boom truck or a pulley system. Make sure the bear's breathing is not impaired.

Climbing spurs or ice crampons may help when a person must climb a tall, limbless tree. Any equipment or ropes can be pulled up afterward with twine.

Drugging Bears in Dens

Black bears in dens are often drugged and handled by researchers in order to study denning physiology and the mechanisms of hibernation. Also, studies on maternity dens, fecundity, and infant survivorship have required the handling of hibernating bears. Failing radio transmitters can be replaced in the den, thus reducing the need for intensive trapping efforts. Denning black bears are routinely drugged and handled, but, as of yet, there have been no successful attempts to handle a denned grizzly in the wild.

Primarily because of the difficulties of winter travel, it is recommended that the den site be located and marked either late in the fall before the heavy snows begin, or in late February after the snow has crusted. Even then, care must be taken not to frighten the bear away. The best time to handle female bears with cubs is during the first 2 weeks of March. Unless the bear is denned at a low elevation near a maintained road or the site can be reached by snowmobile or helicopter, the handling attempt is usually a vigorous all-day affair. At least three people are usually needed to help break trails, pack equipment, remove snow, and handle and move the bear.

When the den site is located, it is important that the bear be drugged as quickly as possible to prevent advanced stages of arousal. There should be little talking and limited movement. Every effort should be made to minimize noise. The drugs and the delivery device should be prepared and kept warm about 50 feet away at a staging site. Short jabsticks and blowguns work best when drugging bears in dens. Be aware that cold weather may affect the mechanics of most drug delivery systems. When drugging bears in dens, a slightly smaller dose may be required because of the bear's lower metabolic activity. Induction times are slower, so wait at least 20

minutes before administering a second dose.

If there is little snow on the ground, you should be prepared in case the bear attempts to flee. Hugie (1978), recommended that a 20 by 20 foot heavy nylon net be placed over the den opening before beginning the capturing and handling process. The four corners and edges of the net were anchored to logs. The net's center was loosely placed over the den entrance. Bears that fled were immediately entangled in the folds of the net, where they were given a hand injection.

Most researchers today do not bother with the bulky cargo nets. Bears can be prevented from escaping by covering the den opening with a shovel or tarp. If a bear does escape and runs downhill after being drugged, it may be impossible to get it back to the den. In this case, a new den will have to be built for the bear.

When the entrance hole has been cleared and a working platform has been made (usually by stomping an area flat with snowshoes and then covering it with a tarp), the bear should be drugged immediately. Given the cramped quarters of most bears and the limited visibility, dosages are usually based more on what you expect the bear to weigh than on a visual weight estimate. If the bear acts aggressive by swatting or by popping its teeth, you may want to halt the handling endeavor. Fortunately, this rarely occurs with denned bears.

After the bear has been injected, closely monitor the bear's position and breathing. Suffocation can occur if the bear slumps forward with its nose tucked under its abdomen, especially if it is wearing a collar. As soon as the bear is tractable, it should be removed and placed on the working platform. Insulate the bear by placing it on a bed of boughs or an ensolite pad. If temperatures are especially cold or wet, cover it with a sleeping bag or space blanket.

If yearlings are present, they are generally more active than the mother. Even so, it is best to drug and remove the mother first. Given the limited visibility in most dens, use utmost care when drugging multiple bears to insure that no bear is inadvertently drugged twice. It may be necessary to use a catch-pole to help pull bears out. Newborn cubs should be tucked inside a jacket next to your body to keep them warm and quiet.

Once the handling process is over, return the bear(s) to the nest and position them on their side. Check the collar to make sure it is not restricting breathing, and that the eyes are not in danger of injury from dirt or twigs. Cover the entrance with a layer of sticks and boughs and then a layer of snow to discourage the bear from leaving and to insulate the den. A small opening should be retained to ensure the bear has a fresh supply of air.

Recording the Bear's Reactions to the Drug

From the staging area, record the drug delivery time and injection site. Watch the bear and record the effects of the drug.

Keep a thorough record throughout anesthesia, making notes on reactions, additional drug injections and the recovery process. If a bear has a high tolerance, or if it becomes excitable or vomits, document this reaction. Bears that fail to respond to the chemical restraint will have to be drugged again.

Once the bear reacts to being drugged, be prepared to move forward in case it topples into an awkward position. A bear in a snare is especially vulnerable because it could land on a sharp stick or break a leg. Also, the bear's head and nose should be positioned with a stick in such a way that breathing is enhanced. Several capture-related deaths have resulted from suffocation because the bear's nose was jammed in the dirt or a corner of a culvert trap. If the bear is in a good position, leave it alone and wait for deep anesthesia.

Before approaching, make sure the bear does not react to noise. Before taking it out of the trap or moving it, prod its tongue, the inside of the ears and between the toes with a stick or jab pole. If the animal flexes its claws, twitches its ears, or tries to bite, back off and wait. If there is no reaction, the bear can be approached from behind. Gain control of the head first before touching any other part of the bear.

If a Cap-Chur dart was used, remove the dart and shake it to see if the internal charge fired. There should be a rattling noise from the charge's internal spring and weight. If the dart didn't fire properly, the bear may be underdosed. Open the dart to see how much drug the bear received. Examine the bear's eyes; with most drugs, the pupils should be constricted. In deep anesthesia, the bear's eyes will be rolled forward (Fig. 30).

Multiple Injections

If a bear fails to become fully immobile, determine its level of anesthesia and administer an additional dose in 20-30 minutes. The amount of the second dose will depend on the level of anesthesia already reached. It is usually advisable to give the animal half the original dose. If a bear fails to enter deep anesthesia even with multiple doses, make a note on the capture form and possibly recommend a different drug for future handling situations. Determine why the bear failed to become anesthetized with the first injection. The reason could be due to any of the following:

1.) Problems with the dart. When internal Cap-Chur charges are put into a dart backwards, the drug will discharge as the dart leaves the barrel. Damp or expired dart charges will fail to activate and push the drug forward on impact. The mechanics of a blow dart or Cap-Chur dart can also fail when the impact against the target is not hard enough. If the distance is too great, or the CO_2 charge is weak, the drug may not be injected into the bear because of an insufficient impact. Some drug may seep into the

Figure 30. Photo of a bear's eyes rolled forward in deep anesthesia. As the anesthesia wears off, the eyes will slowly return to normal (photo by B. Gordon).

muscle, regardless. The dart's Cap-Chur charge can be checked if the bear is in a trap by rattling the dart with a stick and listening for the charge's internal spring and weight.

2.) Needle imbeds in bone. A needle, even when holes are drilled on the side, can imbed into bone or cartilage and fail to release the drug. Needles with a single hole at the tip are more apt to get plugged with bone or cartilage. Occasionally, on impact, the pressure from the drug being released pushes the dart out and the bear receives very little of the drug. A barbed needle usually prevents this.

3.) Underestimated weight. The weight and dose for the bear could have been under estimated, and the drug was thus not potent enough to render the bear unconscious.

4.) Subcutaneous injection. Occasionally, the drug will be released at an angle under the skin where it will have very little effect. Immobilizing drugs injected into fat will also have little effect.

5.) Individual tolerances. Some individual bears, especially adolescents, will never reach an anesthetic plane, even after multiple doses.
These bears have a higher metabolic activity and/or a different blood chemistry.

6.) Dull needles. Occasionally when bears are drugged with a syringe stick or jab stick, dull or large gauge needles will fail to pierce the skin and the drug will discharge onto the hide.

7.) Ineffective drugs. There is never an assurance that a drug is potent. Mistakes are occasionally made when drugs are prepared in the lab. If the history of a drug is not known, or there is a possibility the drug was not stored properly and is no longer potent, dispose or have it tested.

Extending Down Time and Deepening Anesthesia

With some management and research situations (e.g. capturing entire family groups, transporting bears by helicopter, etc.), it may be necessary to give multiple doses to an already sedated bear. Be aware that multiple dosing on an excessive level within a 24-hour period may cause the bear to have unpredictable drug reactions. Different drugs should not be used on a bear until all of the original drug has completely metabolized, usually about 24 hours.

When a bear shows signs of arousal such as twitching its ears, moving its eyes, or jerking its head, either halt the handling process immediately or extend the down time with another injection. Grizzly bears have been known to recover very suddenly when drugged with Ketamine and Rompun. If an additional 30-60 minutes is needed, give the animal half the original dose IV in the tongue or other vein. If less time is needed, use a smaller dose. The bear will go into deep anesthesia almost immediately and will recover from the additional dose sooner than with an IM injection. The body absorbs drugs more slowly when they are delivered in the muscle.

For surgery a bear must be in deep anesthesia. When removing a dart from the body cavity or instrumenting the animal with an abdominal implant, the initial dose should be standard. Just before to the operation, if the bear still responds to pinching, additional drugs should be given. Be aware that even in deep anesthesia there may be some movement, which can be mistaken for signs of revival. Atropine can also be administered at 2 mg/100 pounds subcutaneously if the bear is salivating and having difficulty draining fluid. If the animal is sick or has a massive infection, smaller doses are necessary.

When possible, always relocate bears in culvert traps. If the animal has to be moved in the back of a truck or in a helicopter net, it should be given a heavy drug dose before being moved. Extra drugs and syringes should be available should the bear begin to revive during the trip. If the bear has been drugged several times already, be aware that it may have built up a tolerance.

When trapping and moving family groups or mating pairs, you might have to keep one bear drugged and use it as "bait" to capture the others. (See Appendix I, Capturing and Relocating Entire Family Groups.) If this is the case, the initial dose for the bear used as bait should be heavy. If the down time needs to be extended, give the animal half the original dose.

Additional drugs, antibiotics, antagonists and stimulants are usually delivered by hand injection. Intramuscular injections are recommended for simplicity. Look for a clean muscle on the bear,

trim the hair, and wipe it clean with disinfectant. Draw the drug or antibiotic into the syringe, making sure there are no bubbles. Hold the syringe upright, tap the side, and advance the plunger to push the bubble out. Insert the needle into the muscle and take the pressure off the plunger. If no blood flows into the syringe from a vein, proceed with the injection. Otherwise, select another site.

If an IV injection is preferred, apply pressure to a vein in the tongue or lower leg and deliver the drug into the distended blood vessel. After removing the needle, place a finger over the puncture and rub until the blood coagulates. If an antagonist or respiratory stimulant is delivered in this manner, be prepared for immediate arousal.

Subcutaneous injections are made just under the skin. Pick up the hide and inject the drug between skin and muscle.

HANDLING BEARS

Moving the Bear to a Working Site

As soon as a bear is removed from a trap, it should be moved to a cool, shaded site that has been cleared of sticks, rocks and brush. If the bear is placed on a tarp, it can be pulled or carried to the selected site.

On hot days it is very important that a bear remain cool. Place it in a spot that will have shade all day. Pour water over the bear's femoral area if the weather is warm and the bear had been panting.

The best body position for a drugged bear is on its side or sternum with the head facing downhill to help drain saliva. In a recent study on body positioning in dogs and cats, Henek et al. (1987) discovered that under anesthesia, the heart functions best if the animal is in a lateral position.
However, a sternal position allows for better thermal regulation in hot weather. Surplus heat is lost when the femoral area is placed in direct contact with the moist ground.

As a safety precaution, a snare should be placed on a hind foot when handling grizzlies. The tail of the snare should be anchored to a tree or other solid object.

Initial Examination

As soon as the bear is placed in a shaded working site and fastened to a safety snare, you can grab the preparation kit and begin working on the bear. The preparation kit should contain everything that is needed to monitor the bear through anesthesia and prepare the bear for other handling procedures (see Appendix V).

Once the bear is examined and there is no indication that it is suffering from the effects of the drugging or trapping episode, the handling process can begin. The most difficult and important procedures should be accomplished first, such as fitting the bear with a radio collar or collecting a tooth and taking blood. The simplest and least important procedures, such as taking body measurements, should be saved for the end of the handling period. That way, should the bear begin to revive prematurely, there will be no need to extend the down time.

Locate the dart wound and trim away the surrounding hair. Spray the site with Furazol. If you cannot find the dart, look for it on the ground. If you cannot find it on the ground, check the bear over immediately for a dart wound. Next, apply a bland ophthalmic ointment such as Lacri Lube to the bear's eyes and cover the head with a hood or scarf. Make a note of any rapid eye movement or dilation of the pupils. Estimate the bear's weight with a Hog Girth Tape or measure the chest circumference and compare it

to a bear weight/chest circumference chart (Table II). If the bear was overdosed or underdosed, make a note on the trap form. Place a thermometer into the bear's rectum and begin a head-to-toe examination.

Check the bear over carefully for any wounds, growths or parasites. Is there any blood or mucous in the nostrils? Discharge from the nose could indicate an illness or injury. Check the condition of the teeth and make a note of the bear's estimated age and describe any chips or fresh breaks. Look for

Table II. Chest girth-weight relationships for black and grizzly bears (Aune; unpubl. data).

CHEST GIRTH (inches)	GRIZZLY BEARS (lbs.)	BLACK BEARS (lbs.)
20	70.81	52.98
21	75.26	57.23
22	80.00	61.81
23	85.03	66.75
24	90.38	72.10
25	96.06	77.87
26	102.10	84.10
27	108.53	90.83
28	115.35	98.10
29	122.61	105.95
30	130.32	114.43
31	138.52	123.59
32	147.23	133.49
33	156.49	144.17
34	166.33	155.71
35	176.80	168.17
36	187.92	181.64
37	199.74	196.17
38	212.30	211.88
39	225.65	228.83
40	239.85	247.15
41	254.93	266.93
42	270.97	288.63
43	288.01	311.38
44	306.13	336.30
45	325.38	363.22
46	345.85	392.29
47	367.60	423.69
48	390.72	457.60
49	415.30	494.23
50	441.42	533.79
51	469.19	
52	498.70	
53	530.07	
54	563.41	
55	598.84	
56	636.51	
57	676.55	
58	719.10	
59	764.33	
60	812.41	

and remove any wood splinters caught between the bear's teeth if the bear was caught in a snare. Does the bear have an old tattoo? Make a note if the animal has raspy breathing or gurgling noises in the chest. Check for traces of vomit and make a note of excessive salivation. Feel around the ears and look for ticks and mites, scabs or blood. Has the animal ever been ear-tagged? Work your way down the body, feeling the limbs and ribs for breaks and old injuries. Feel the abdomen area for any swelling or bloat from internal bleeding. Look at the genitals and anus and make a note of any swelling, bleeding or sores. Check the trap site for diarrhea. If the scat is dry and hard, be aware that the bear could be dehydrated. If there are any serious wounds, treat them immediately.

Monitoring a Bear

The animal's breathing, temperature and heart rates, which vary with the drug being used, need to be monitored about every 15 minutes. Record any changes in breathing and depth and rate of sedation. Take a pulse by feeling the heart or placing a finger on the femoral triangle or carotid artery. Continually check the animal for response to noise and touch. Sharply tap the tip of the rostrum with your fingertips every 5-10 minutes if using Ketamine and Rompun. Monitor the eyes. As anesthesia wears off, the eyes will become less medial and ventral.

According to Wallach (1978), the normal rectal temperatures of adult bears is between 99.6 degrees F (37.5 degrees C) and 101.0 degrees F (38.3 degrees C). The normal heart rate of ursids varies between 60 and 90 beats per minute, with the higher rates noted in cubs. When a bear's temperature goes below 96 degrees and continues to fall, the animal should be warmed. When the body temperature goes above 104 degrees, the bear should be cooled immediately (Hellgren and Vaughan 1989). The normal respiratory rate is between 15 and 30 breaths per minute. When respirations drop below five respirations per minute or the bear begins hyperventilating, appropriate action should be taken.

Some observable symptoms of an animal suffering from a lack of oxygen are decreased body temperature, increased respiratory rate, elevated pulse rate, vomiting, twitching, and convulsions (Lumb 1963). Also, the tongue and lips should be checked occasionally for blue color, another sign that there is a lack of oxygen. Pink gums indicate the bear is doing well. Ashen grey gums means the animal is in shock. Check the blood pressure occasionally by pressing the gum and timing the capillary refill time. If the capillary refill time is more than four seconds, you should become concerned. If the animal shows any of these signs, act immediately (see section on treating anesthetic emergencies).

Antibiotics

Injectable antibiotics should not be administered to every captured bear. Unneeded doses of antibiotics are of no benefit. If the animal is suffering from an infection, has undergone intensive surgery, or has a serious wound, then it may benefit from a shot of antibiotics.

LA 200 (Oxytetracycline) is the recommended antibiotic for bears. This antibiotic has a three day spectrum and does not need to be refrigerated. The recommended dose for LA 200 is 100 mg/22 pounds. If the bear has severe injuries, double the dose. LA-200 causes pain when injected; therefore, it should be injected into several different sites (Van der Schraff pers. comm.). Another common injectable antibiotic is Dual-Pen. It is not as long-acting as LA 200 and needs to be refrigerated. Topical antibiotics such as Furazol or Scarlex should be carried in the kit and applied routinely to all cuts, punctures, and abrasions.

Radio Telemetry

General Notes

Radio telemetry has been very useful in bear research and management. It has allowed for the detailed study of habitat requirements, food habits, daily movements, population dynamics, behavior, and relationships with man. Abdominal transmitters and transmitters with sensors are now used to study survivorship and detect physiological conditions, while satellites are able to monitor bears continually and relate their movements to specific habitats. Darting collars allow bear biologists and managers to recapture study animals at will. Every year transmitters and remote devices are being developed that are more compact, more reliable, have extended battery life. Because of the cost of telemetry equipment and the effort required to capture bears, it is imperative that the animals be instrumented properly in order to obtain maximum data, while at the same time causing minimal discomfort for the study animal.

Radio Collars

Radio collars have been successfully used in bear research since the early 1960's (Craighead et al. 1965). Most collars are constructed of neoprene impregnated conveyer belting that is about 1 1/4 inches wide. The battery, antenna, and telemetry device is usually encased in flexible uralane plastic. Collars can be purchased pre-built from several different companies that specialize in wildlife telemetry, or the materials can be purchased separately and the collars built by the researcher (Blanchard

1985).

Extra precaution must be taken to insure that all collars are attached properly. The collar should not restrict breathing, interfere with day-to-day life, or cause undue discomfort. This is especially true when instrumenting bears with the larger satellite and darting collars, which are more bulky. All collars tend to hang straight down with the weight of the transmitter. During feeding activity, however, collars are prone to rotating. This can be a problem with darting collars, which are designed to inject an immobilizing drug in the upper neck when activated by radio signal (Mech et al. 1984).

Even when properly attached, collars may cause chaffing and callousing on the neck and chin. If collars are not put on with care, the collar belting could cause severe chaffing and skin abrasions, leading to open sores and infection. It is important to allow enough space under the collar so that air is allowed to circulate. When collaring young bears, especially males, it is extremely important to attach the collar in such a way that it will expand as the bear grows, or so that it will fall off if the collar becomes too tight. Every collar should be attached with a system which allows the collar to break away after 2 or 3 years. There have been a number of recaptured and hunter-killed bears that have had severe collar-related injuries due to improper instrumentation.

To attach a collar, first remove the magnet from the collar and check out the transmitter's frequency and number of beats per minute with the receiver. (The magnet deactivates an internal switch.) Pace off the distance the collar transmits with the receiver without the antenna, and record the distance. This will be helpful when you have to pick up the collar or radio track the bear from the ground. If the transmitter is motion-sensitive or has a mercury tilt switch, make sure the collar is placed correctly on the neck with the front side of the collar forward. The collar should be in slow mode when the bear has its head up and in fast mode when the bear is feeding.

Take the collar and loosely attach a canvas splicer (mold treated canvas webbing equipped with grommets) to the short end. Measure the fit around the widest part of the skull with the collar, which is in front of the ears and over the eye orbits (Fig. 31). Mark the spot with a pen and then place the collar around the bear's neck to check the fit. Attach the collar together with a set of vice grips. Trim off the excess belting, leaving about 4 inches more than appears necessary. Remove the vice grips and tape about 8 inches of the belting that was trimmed off to the inside of the collar with electrician's tape. Never use duct tape because the adhesive can be irritating. This extra piece of belting should ride on the upper side of the bear's neck when finished (Fig. 32). The tape will wear through in several months and the extra belting will fall out, giving the bear some extra room. By this time the bear will be accustomed to wearing the collar and will not take advantage of the extra space by pulling the collar off. This extra belting should be placed on the collars of all bears with the

Figure 31. Sizing a collar around the widest part of a bear's head. Note the snare around the bear's foot as a precautionary measure (photo by D. Limzy).

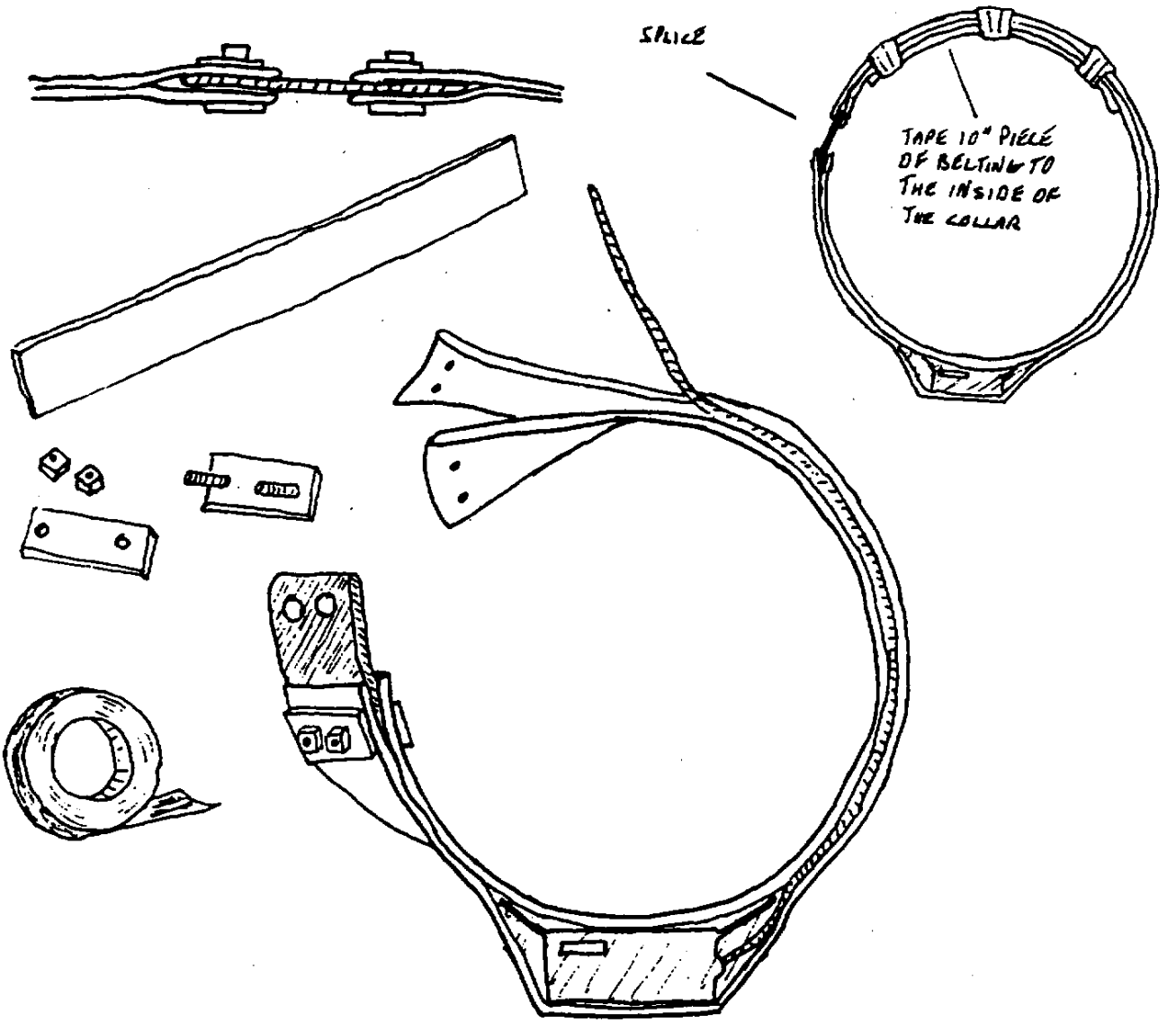

Figure 32. Illustration of a bear collar with a canvas spacer.

possible exception of obese adults in the late fall.

While holding the collar together with the vice grips, slip it over the bear's head. The collar should be snug going over the bear's ears, but you should be able to rotate it around the bear's neck with ease once it is on.

Pull the collar off, remove the vice grips, and bolt the collar together with the appropriate hardware. You may have to fold the ears and pull the skin to get it off. Slip the collar back on the bear, checking to see if it is still snug going over the ears. Never place a collar on a bear that cannot be slipped off! When finished, you should be able to slip a flat hand under the collar belting of a fall bear, and two hands under the belting of a young or early-summer bear. If you need to make the collar larger, rivet or clamp on additional belting. Any exposed antenna should be covered with either belting or electrician's tape.

As a rule, cubs of the year and small yearlings should not be instrumented unless the collar is attached with a splice that will expand or rot off quickly. Sub-adult bears, especially male grizzlies weighing less than 250 pounds, should be fitted with a lighter weight canvas splice or a splice that has had the edges cut so that only about 3/4 of an inch remains. A third option is to fit these bears with an expandable collar (Blanchard 1985; Fig. 33).

To attach an expandable collar, first size and mark the collar where you expect the best fit around the neck. Punch the necessary holes with a leather punch. Slip the three neoprene belt sleeves over the outer strapping. On the inner strapping, tape the elastic splice so it will not stretch. With scissors, taper the internal strapping and then rivet the belting on either side of the elastic splice. Slide the internal strapping with the expandable splice between the outer belting and the attached belt sleeves. Rivet or bolt the elastic splice at the marked spot. Be careful not to expand the collar. Slide the three sleeves up to where the inner and outer belting overlap and rivet them to the outer belting. Tape the collar up tightly with one wrap of electrician's tape. Put two or three additional wraps over the spot where the inner and outer belting comes together, up to where the internal expanding splice is connected to the outer sleeve. Make sure the collar does not expand, and pull it over the bear's head. The tape will keep the collar from expanding until the bear gets used to the collar. Through time the tape will deteriorate, and the collar will grow with the bear. These collars come off easily when they are hooked on limbs or pulled on by siblings.

Adult males are very difficult to collar. A big male can go from weighing 400 pounds to 900 pounds in three years. Some of the worst collar-related injuries have been documented on adult males. Also, there is a tremendous seasonal variation in neck

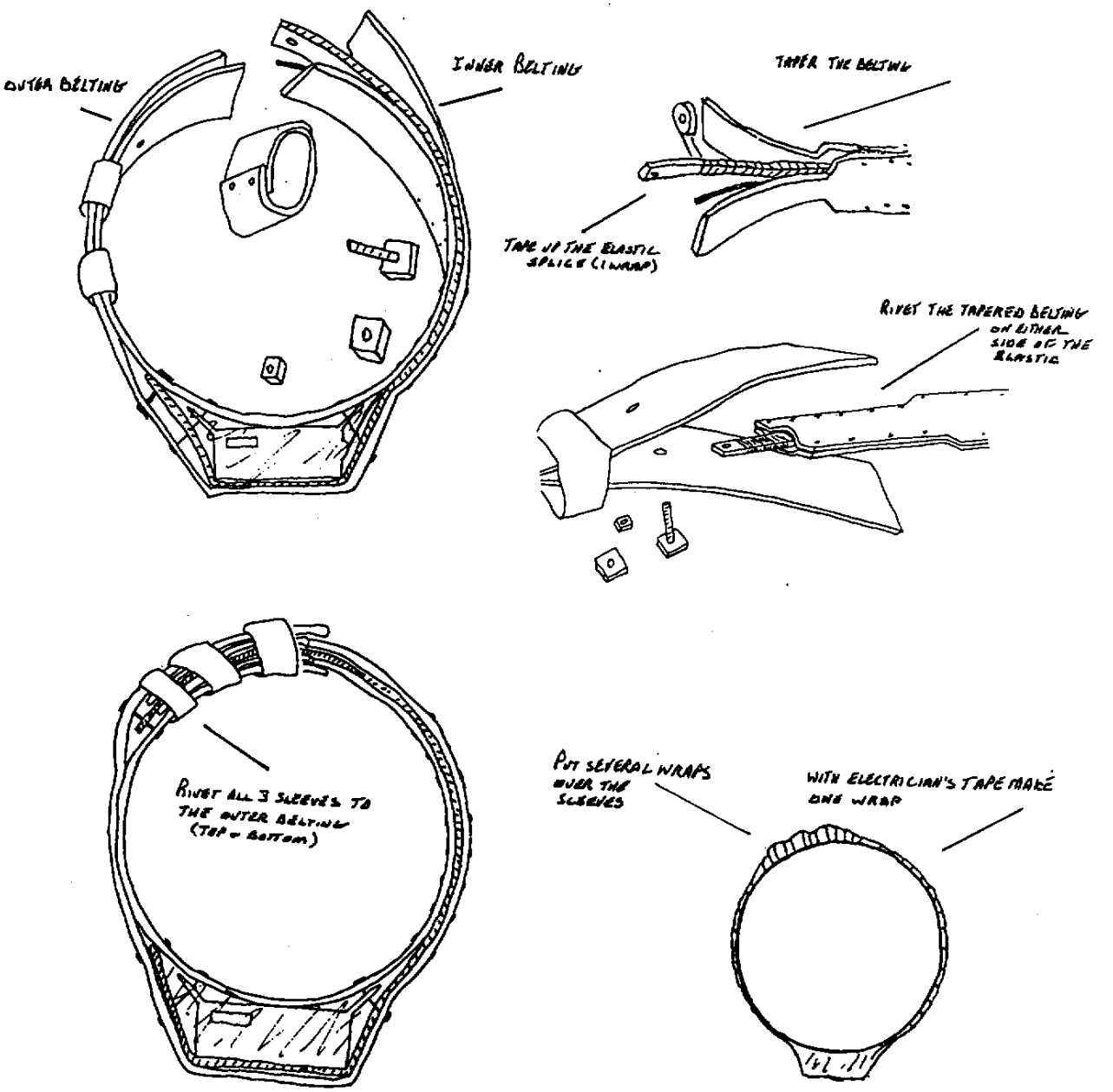

Figure 33. An expandable collar for subadult bears.

size. In the spring and early summer, males appear to develop thicker necks during the breeding season. Between midsummer and fall, they can gain hundreds of pounds. At times, the neck diameter may be slightly larger than the head. Also, males are very hard on collars. The canvas splices seem to rot sooner, and the transmitters and antennas seem to corrode and malfunction more often on males. This might be attributed to neck secretions (Blanchard 1985). Also, big males seem to be more apt to lose collars, especially when they fight with other males. A heavily taped expandable collar can also be placed on big males to help reduce the chance of injury. When males are collared, it helps to trim a groove for the collar in the neck hair. Loose collars can be made temporarily tighter by taping an extra length of belting to the inside of the collar or by gluing neck hair to the collar.

When a bear with a collar-damaged neck is recaptured, it can be re-fitted with a loose radio collar. The wound will heal with the increased air circulation.

Usually, if a bear is unable to remove a collar in the first few weeks, it will probably accept its presence. The splice, through time, will eventually tear or rot. The trick is to find a splicing system that rots off just before the batteries in the transmitter go dead, or if the collar becomes too tight. Transmitters powered with lithium batteries have an average life of three years (Blanchard 1985). Basically, the heavier the canvass, the longer the splice will last (see Appendix V for needed equipment).

Ear Transmitters

Ear transmitters have been used on bears, but generally with unsatisfactory results. Ear transmitters are attached to the inside of the ear like an ear tag, with a whip antenna protruding from the tip of the ear (Servheen et al. 1981). They were developed for younger bears to alleviate the risk associated with collaring. However, problems were documented with the antennas breaking off within a couple of months, and also with torn ears. Further research on the use of ear transmitters for bears is recommended.

Hair Transmitters

This technique has been effective in seal research (Fedak et al. 1983) and has been tested on bears (Anderka 1987, Aune and Mace pers. comm.). Hair transmitters are especially useful for cubs and yearlings. First, the hide and hair just behind the shoulders must be thoroughly cleaned with a solvent such as acetone to remove dirt and natural oils. The transmitter, which is riveted to a piece of 1/4-inch nylon mesh that is 4 X 4 inches square, is then placed onto the cleaned site and hair is pulled through the holes of the mesh with a crochet hook. The tips of the hair that is protruding

through the mesh is glued together with an epoxy. Take care so none of the epoxy makes contact with the skin. The transmitter will remain attached to the bear until the animal sheds (Fig.34).

Transmitter Harness

This technique has been effective for attaching satellite transmitters to polar bears (Taylor 1982, Larsen et al. 1984), but will not be discussed in detail in this manual. The transmitter is built into a collar that is placed loosely around the bear's neck. A body harness of stainless steel cable covered with rubber tubing holds the collar in position. The harness is constructed for the individual bear and is held together with magnesium bolts. These bolts corrode in salt water, allowing the harness to fall off in approximately 1 year.

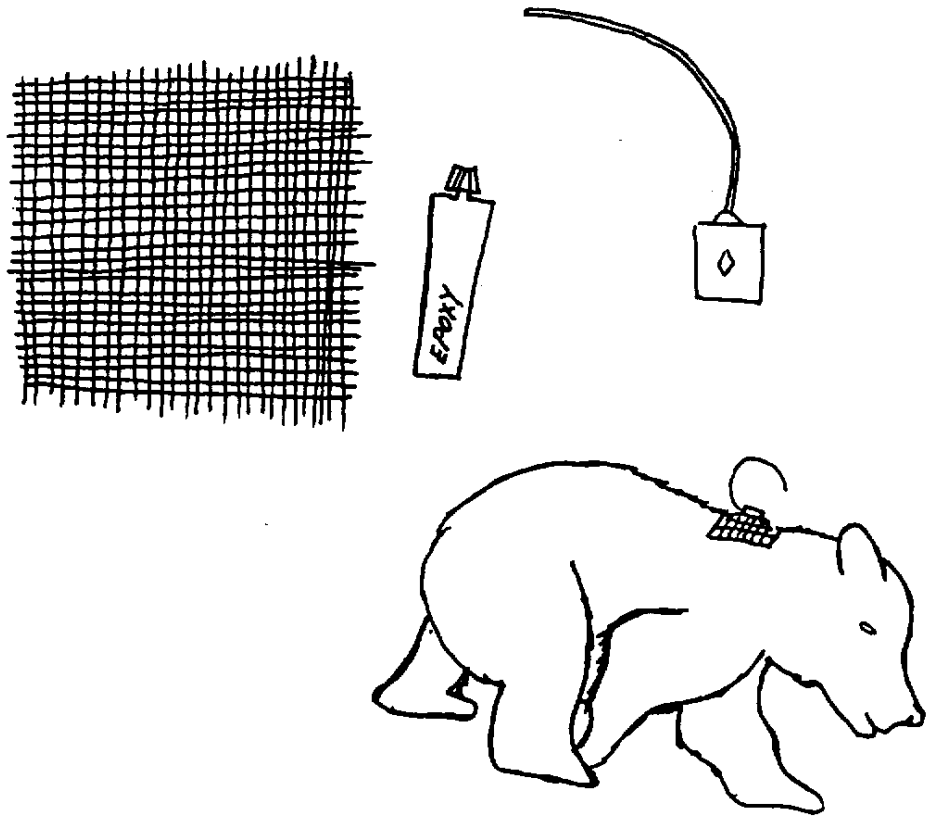

Figure 34. A hair transmitter for use on young bears.

Abdominal Implants

The field of bio-medical telemetry is developing rapidly and will soon be an integral part of bear research. Abdominal transmitters in bears will be useful for recording the impacts of poaching, cub survivorship, and physiological information. Body implants will enable biologists to gather data on internal body temperatures, blood pressure and flow rates, and heart and brain wave patterns of free-ranging and hibernating bears. The implants currently used on bears are 18 cm long and have about the same circumference as a fifty cent piece (Telonics Co.). The transmitter, battery and coiled antenna are encased in electrical resin and wax. The battery life of the implant is about three years. Currently, abdominal transmitters have limited use in free-ranging bears because of their relatively poor transmission. The signal is blocked by the mass of the animal's body, and if the bear is not instrumented with a neck transmitter as well, the internal transmitter is sometimes next to impossible to locate from any distance, even from the air. The range of the transmitter is about a half mile when located from an airplane 500 feet above the surface (Stradely pers. comm.). Abdominal implants are recommended over subcutaneous or muscle implants because there is less of a chance for infection.

Inserting an abdominal implant into an animal is not a problem as long as the procedure is kept sanitary, and the individuals conducting the work have surgical experience. When possible, the bear should be brought to a clinic where the procedure can be carried out by a veterinarian. Individuals without surgical experience should not attempt this procedure on bears in the field!

Certain supplies are necessary for installing abdominal implants (see Appendix V for necessary materials). The following technique is recommended by veterinarian Marian Van der Schraaf, who has done the procedure on black bears and grizzlies. Telazol is the recommended drug for anesthetizing bears that receive an abdominal implant. The entire procedure will take at least half an hour.

Procedure for Abdominal Implants:

1) Once the bear is anesthetized, it can be brought to the working site and placed on a clean tarp. The bear should be placed on its back, with the head off to one side and slightly downhill to allow fluids to drain. If needed, prop the animal up by placing logs under the tarp along the rib cage. Tie off the front legs so they will not interfere with the operation. If there are a lot of flies or mosquitoes, spray the bear heavily with bug repellant.

2) Make sure the bear is in deep anesthesia. Pinch the bear's belly skin with a hemostat and look for any reaction to pain. If more drug is required, give the bear at most half the original dose. Deliver the drug IV in the tongue. If the bear is

salivating excessively, give it an injection of Atropine (2 mg/100 lbs IV.) Atropine dries up the body's secretions, but a major side effect is rapid heart beat (tachycardia.) If the bear's heart is beating rapidly (eg. > 100 bpm), do not administer Atropine.

3) Trim and shave a 6 x 9 inch area in the middle of the bear's stomach from just above the belly button toward the genitals. If the bear is a male, use a towel clamp to pin the penis off to one side. Pour Nolvasan and water into the surgical tray and put the implant, surgical tools, sponges, scissors and suture material into the solution. Everything should be completely submerged. Make sure you remove the magnet from the transmitter and double check the frequency (Fig. 35).

4) Begin the surgical scrub. Pour sterile solution on the shaved area, and with a sterile gauze, clean the site. Start cleaning in the middle and with a spiral motion clean outward. Do not go over the same site twice with the gauze. Do this a total of three times using new solution and gauze each time. Do not contaminate the site afterwards. Open up the sterile drape

Figure 35. Preparing a bear for an abdominal implant.

packet, but do not touch the sterile drape. Place it in such a way that it can be taken out of the packet later with sterile gloves.

5) Put on the face mask and hair net or hat. With clean hands, open the sterile glove packet and lay it on the tarp so the gloves are facing you. Only touch the outside of the packet. Remember the inside of the envelope is sterile, and it can be used as a tray if it is kept clean. Put the gloves on by only touching the inside of the gloves. Use your gloved fingers to pull down the cuffs. Do not touch your bare skin or anything not in the sterile solution.

6) Remove the sterile drape from the packet and lay it over the shaved area. Clamp the drape to the bear's skin with the remaining towel clamps. If the bear reacts to the pinching from the towel clamps, have an assistant administer more Telazol. Cut a 2 x 4 inch notch in the drape just below the umbilicus toward the crotch. The notch should be directly over the linea alba, the midline formed by the connecting site for the abdominous muscles.

7) Select a scalpel blade packet from the sterile solution and place it on the scalpel handle. Cut a 4-inch midline incision through the skin to the abdominal wall. Never cut with the tip of the scalpel; always use the rounded portion of the blade to prevent unintentional punctures. Hold the scalpel like a pencil. Try not to cut through the rectus abdominous muscle, which is on either side of the linea alba. The peritoneum will be hard and white. Take a sponge and wipe away any blood.

8) Pull the abdominal wall up and away from the intestines with a forceps and nick the peritoneum with the scalpel. Put the forceps into the hole and pick up the peritoneum and very carefully cut a midline incision through the abdominal wall. Continue holding up the abdominal wall and reach in with several fingers. Make a little pocket for the implant inside the abdominal cavity. Slip in the implant (make sure it is properly functioning first!) The implant once inside should be free-floating and not interfering with the intestines (Fig. 36).

9) Suture up the peritoneum using a monofilament nonabsorbable suture no smaller than 4-0. Using the forceps and the needle holder, sew in four or five interrupted surgeon's knots (one or two more wraps than a granny knot). Next, suture up the wound through the skin using heavy absorbable suturing material. Use a subcutaneous suture; that is, do not sew through the skin, but rather sew together the connective tissue just under the skin. Go through the skin at the top of the incision and tie a knot in the end, then suture together the subcutaneous tissue all the way down to the bottom of the incision. Tie a knot. If needed, close the skin up with another series of interrupted stitches. The more suturing the better. You do not want the bear tearing its stitches

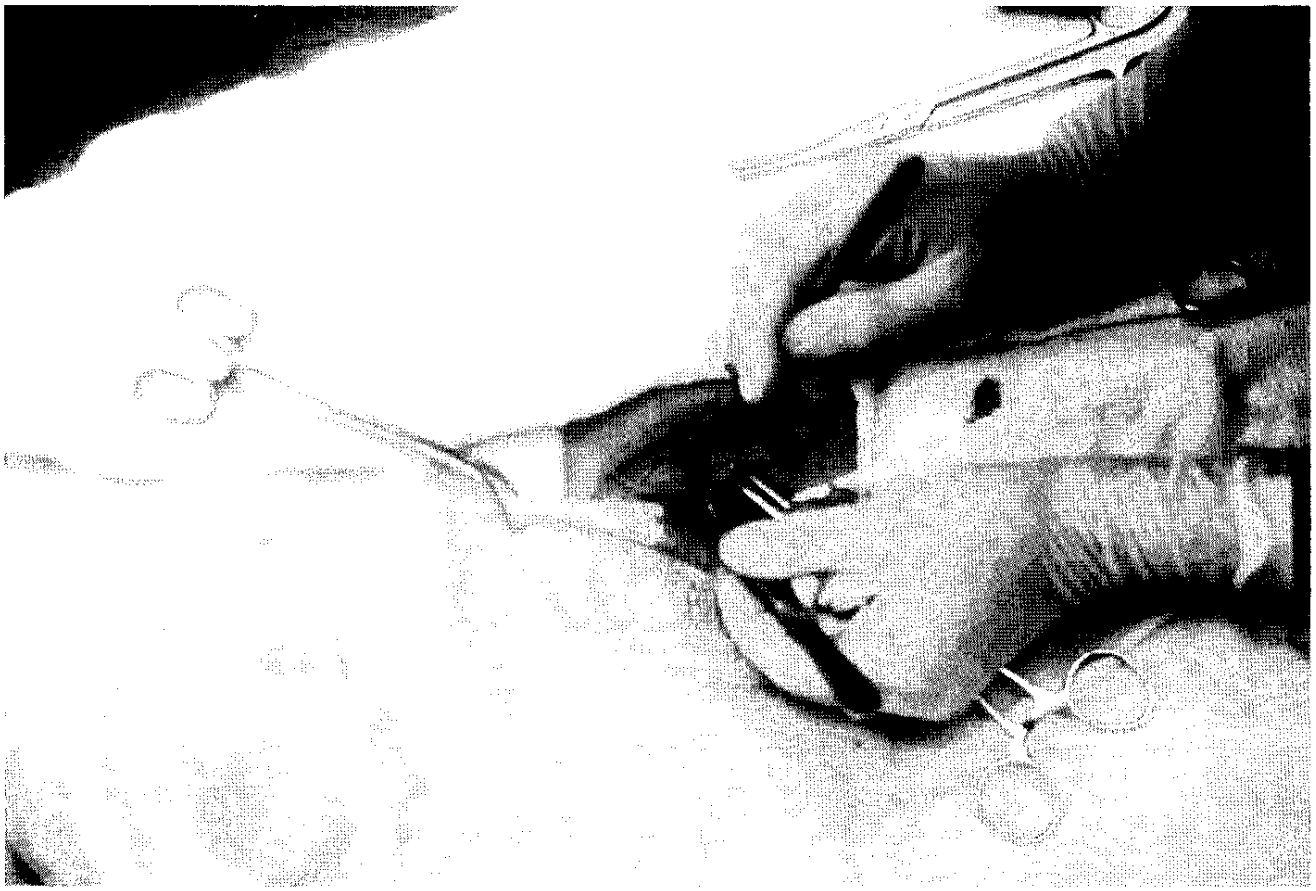

Figure 36. Making a midline incision for inserting an abdominal implant.

out later in the day. If the process was done in a sterile manner, the wound should heal quickly (Fig. 37).

10) Pick up your gear and spray the implant site with Furazol. Give the bear an IM injection of LA 200, a long acting antibiotic. (See delivering antibiotics to a bear.) Lay the bear on its side in the shade and monitor its recovery. Check the signal from the transmitter and test its range from the ground.

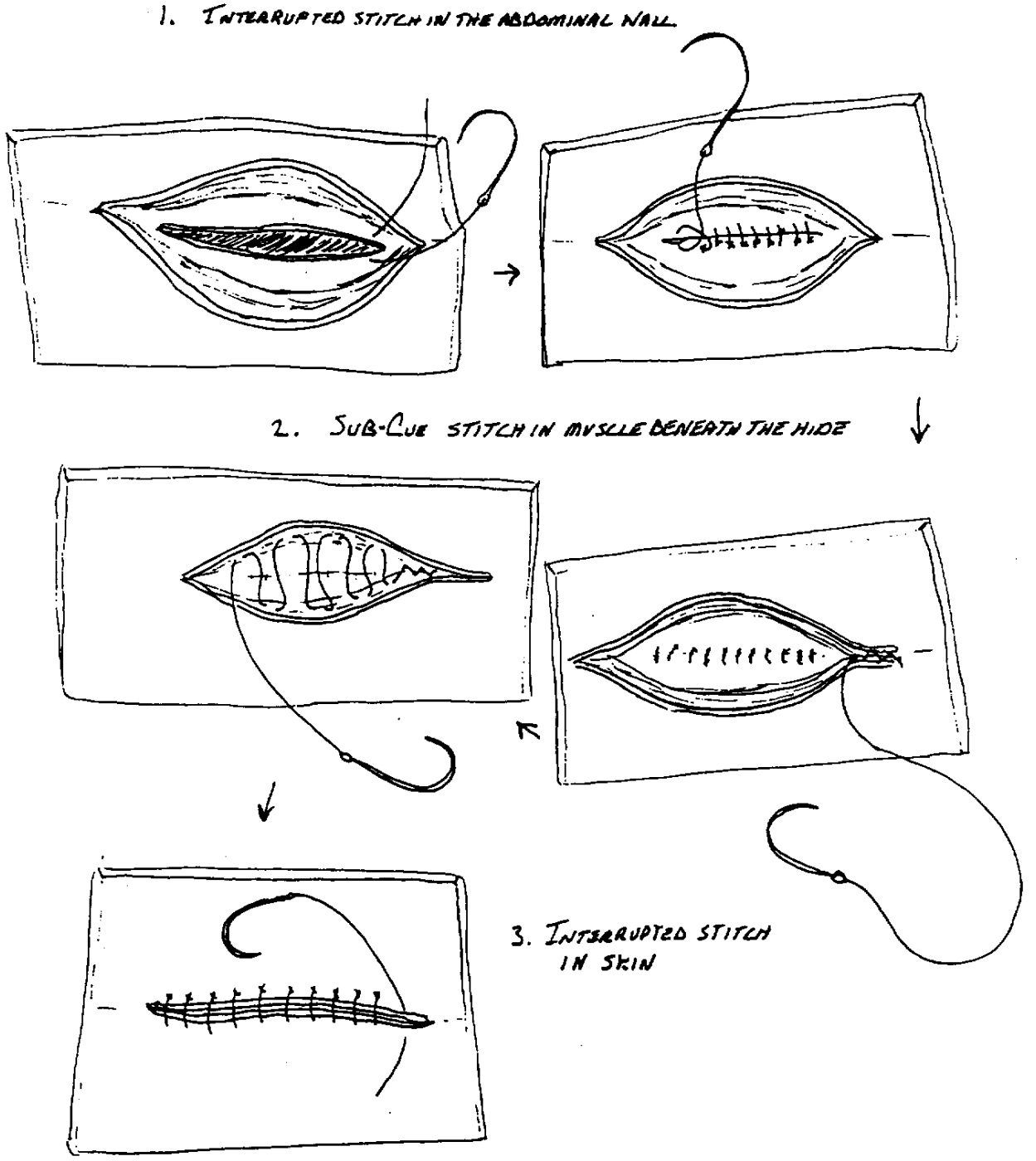

Figure 37. Suturing an incision following an abdominal implant.

Marking Devices

Wildlife researchers and managers are often criticized for marking wildlife with neck collars, ear tags, or leg bands. Many people feel that the animal's self esteem is taken away, and the experience of seeing a wild animal is reduced when it has been visibly marked and knowingly handled.

It is important that captured bears be marked. If the effort to capture and handle a bear is warranted, then as much information should be gathered and recorded on that bear as possible. Bears can be marked in a variety of different ways, but it is suggested that all bears be ear tagged and tattooed. Marking bears by freeze branding works well, but the amount of equipment needed makes this technique impractical. Ear notching can also be used as a method of permanent marking when nothing else is available (LeCount 1986).

Ear Tags and Streamers

There are a variety of plastic and metal ear tags on the market. Colored plastic Roto-tags and rubberized button ear tags appear to cause the least amount of irritation to a bear's ears. However, there are some researchers who still prefer the metal paddle tags. Whatever is preferred, it is recommended that an ear tag be placed in each ear. Bears occasionally loose one tag but rarely two, thus increasing the chances of permanently marking a bear (LeCount 1986). Males tend to lose ear tags during fighting, and cubs will often chew ear tags off siblings and females.

Different colored tags can be used for field observation. Plastic roto tags come in a variety of sizes, shapes and colors, and can be used to distinguish between sexes and bears trapped in different years or regions. Make sure not to duplicate ear tag numbers among different bears. You should have a record of all ear tagged bears in the kit.

To tag a bear, select a spot midway in the back of the bear's ear and about 1" from the outside edge. Trim away the hair with a small scissors on both the inside and outside. With a leather punch, make a clean hole through the cartilage, avoiding any visible blood vessels. Spray the wound with Furazol. Snap on the ear tag with the proper ear-tagging tool, with the point of the tag to the outside of the ear. Be sure to record the ear tag numbers and color on the capture sheet and on a master list (see Appendix V for necessary materials).

Some researchers will further mark a bear by attaching 2 X 5 inch streamers of Armatite or Ritchie Material to the back of the button or roto tags (Kasworm and Manley 1988, Thier 1990; Fig. 38). The material comes in a variety of colors, will last several years, and is especially helpful in population studies. The streamers can be individually marked with a permanent marker

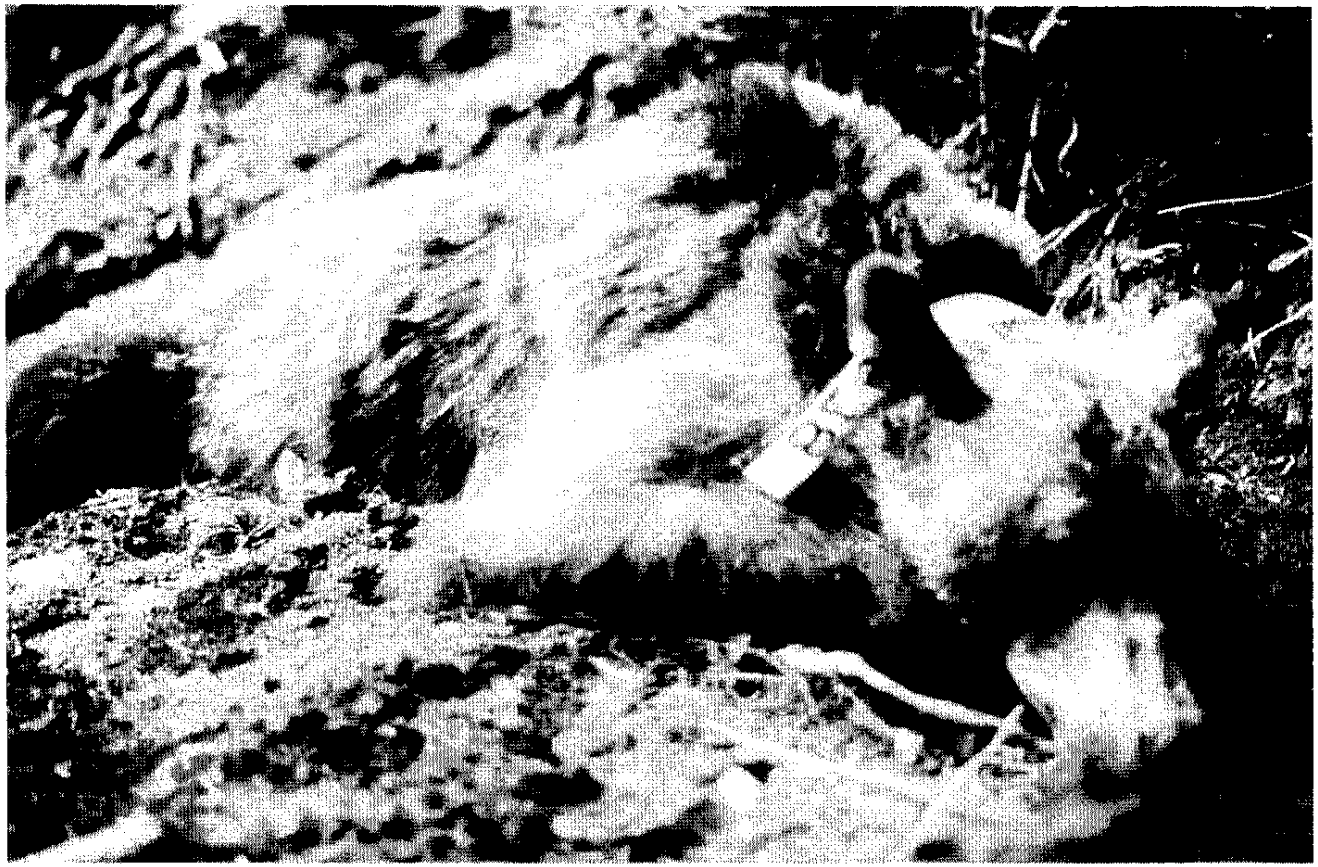

Figure 38. A bear marked with ear tags, ear streamers, and a radio collar (photo by T. Thier).

that will allow the identification of individuals from a distance or by remote-sensitive cameras. Some researchers will individually mark bears by riveting marked and colored pieces of armatite to the radio collars.

Tattoos

A lip tattoo is sometimes the only way of documenting that a bear had been previously captured. Plastic or rubberized ear tags tend to break off after 4 or 5 years. If a bear has ripped or suspicious looking holes in its ears, it may have been ear-tagged at one time. If the animal has a tattoo or a remnant of a tattoo, then it was definitely handled. Often, even the most illegible tattoo can be used to determine when and where a bear was originally captured. By looking at the age, scars, distinguishing marks, hair color, and sex of the bear and comparing it to old trapping records, the animal's identity can usually be determined.

Tattoos are made by impregnating ink into the skin of a bear with special tattoo pliers. Rub ink onto the desired tattoo site and clamp down on the area firmly for ten seconds with the tattoo pliers, which hold needles in the form of numbers and letters. Check out the puncture pattern. It is important to make sure the tattoo punctures are deep and filled with ink. To insure that ink enters the tissue, the puncture wounds can be nicked again with a needle. Rub more ink onto the site using a toothbrush with firm bristles. Also, if a premolar has been removed or the bear has some cuts on its gums or body, rub in some ink and make a note of the site on the trap form. A battery-powered tattoo gun can also be used. The best place to tattoo a bear is on the lower or upper lip. Bears can also be tattooed in the armpit or femoral area. The tattoo number should correspond to the ear tag number. Have a list of previously used tattoo numbers to cross reference (see Appendix V for necessary materials). One can also apply tattoo ink to the nose and make several nose prints on the back of the trap form for future identification.

Weighing Bears

When possible, all larger bears should be weighed on a 500 pound scale. Bears smaller than 100 pounds should be weighed on a 100 pound scale. All scales should be periodically tested for accuracy. Most bears are weighed by placing them in a tarp or net and then hoisting them into the air by some means. While nets or tarps certainly work, they are bulky and will frequently catch on sticks and branches. Also, breathing is restricted when bears are bunched in nets, and several bears have nearly died when their breathing was cut off by their limp tongues. A better method is to make a pair of cuffs out of soft 3/4" rope. Simply take two 18-24" lengths of rope and tie a sliding noose on the four ends. Slip a

noose over each foot, crossing front to back. Attach the hook of the scale to the cuffs before hoisting (Fig. 39).
Smaller bears can be weighed from a pole suspended between two people. Larger bears can be weighed from a tree limb with a block-and-tackle or a come-along. They can also be suspended from a tripod made of 10-foot long wooden poles or aluminum conduit. The scale can be directly attached to the top of the tripod. By "walking" the base of each pole forward one at a time until the bear is suspended, the weights of large bears is usually easily obtained (Fig. 40).

If a bear "bottoms out" a 500-pound scale, it can be accurately weighed by fastening the bear so it will hang from the middle of a sturdy 12-foot long pole. One end of the pole can then be placed over a 5-foot high limb. The free end of the pole is hooked to the scale. Hoist the scale, pole and bear into the air. When the bear is free of the ground and the pole is horizontal, the scale reading is one-half of the bear's actual weight (Fig. 41).

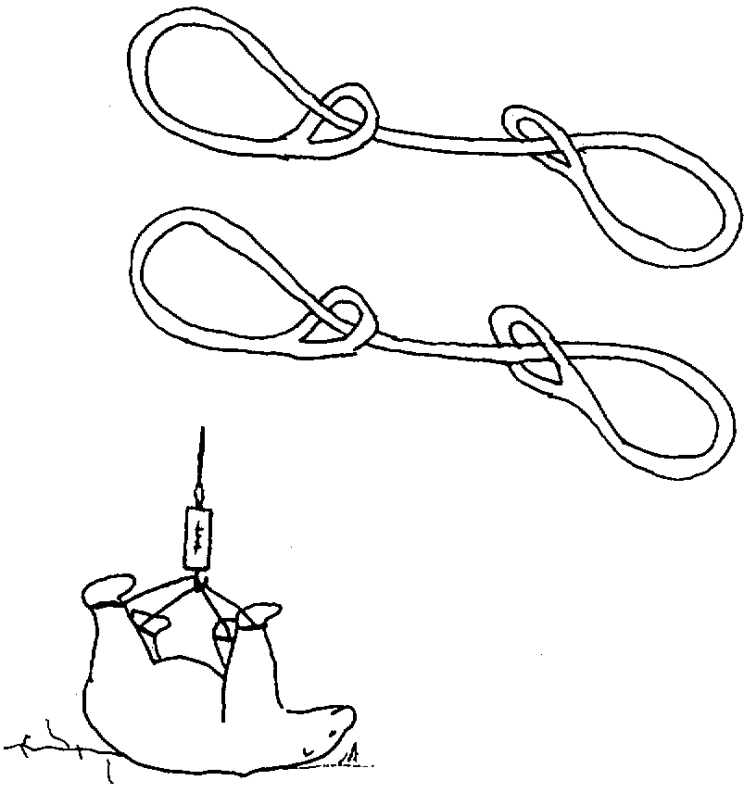

Figure 39. Using rope cuffs to weigh a bear.

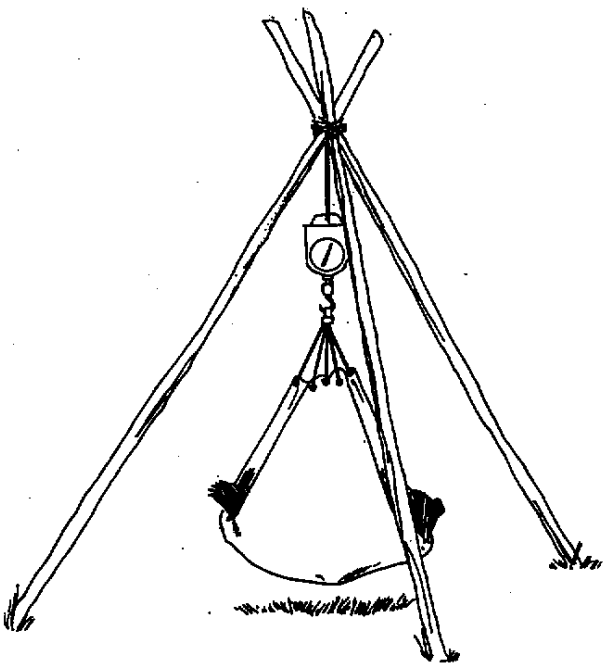

Figure 40. Weighing a bear with a tripod system (drawing by N.Wiegert).

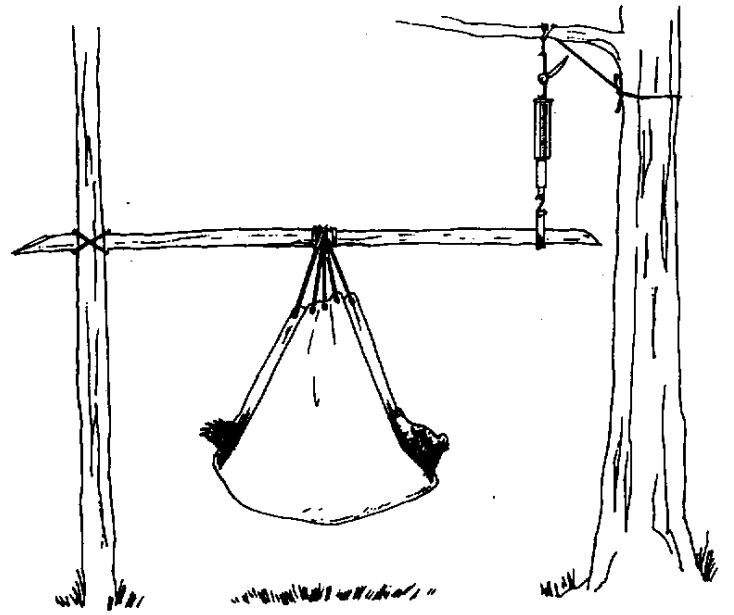

Figure 41. A method for weighing bears that bottom-out a scale. Using this method, the scale will read 1/2 the bear's weight (drawing by N. Wiegert).

If a scale is not available, a rough estimate of the bear's weight can be collected with a commercially sold hog weight tape. The hog tape is used to correlate weight to the chest circumference. The bear's chest circumference can also be later compared to the known weights and chest measurements of previously captured bears.

Taking a Tooth

An upper or lower first premolar (PM1) should be removed from every captured bear (except cubs and possibly yearlings) for age determination (see section on "Estimating the Age of a Bear by Tooth Wear"). If there is any question as to the age of the bear, take a tooth. Ages are determined in a lab by counting the cementum annuli in the tip of the root. Some researchers prefer a middle incisor for aging purposes, where they believe the cementum annuli are more pronounced. Other biologists feel that incisors are too important to bears for feeding and should therefore be left alone. The first premolar in bears is a small, unimportant tooth that is being lost through evolution and may not even be present in some bears (Craighead et al. 1970, Wiley 1974).

Never use force when removing a tooth. Take your time and loosen the tooth completely from the gum before extracting it. You should never pry on the tooth, or the root may break inside the gum, which could lead to infection.

Using a tooth elevator, loosen the gum surrounding the premolar. Work the instrument around and against the tooth until it is completely loose. You may have to work around the tooth several times, going slightly deeper each time. Using a tooth extractor, pull the tooth straight away from the gum with a steady, even pressure. To control bleeding, place a small ball of cotton on the site. Remove the cotton after 10 minutes.

Place the tooth in a paper envelope, taking care not to expose the tooth to any type of grit or dirt. Label the envelope with the bear number, date, sex, drainage, and study area. After the tooth has partially dried, remove any attached flesh with your thumbnail. If necessary, soak the tooth for 20-30 minutes to loosen the tissue. Never boil the teeth, and never store in a plastic envelope or air-tight container (Fig. 42).

Collecting Samples

Venous blood, tissue, and other samples are collected from bears for many reasons. By analyzing blood, for example, you can check for antibodies to see if the animal has been exposed to bacterial or viral diseases. You can also document blood

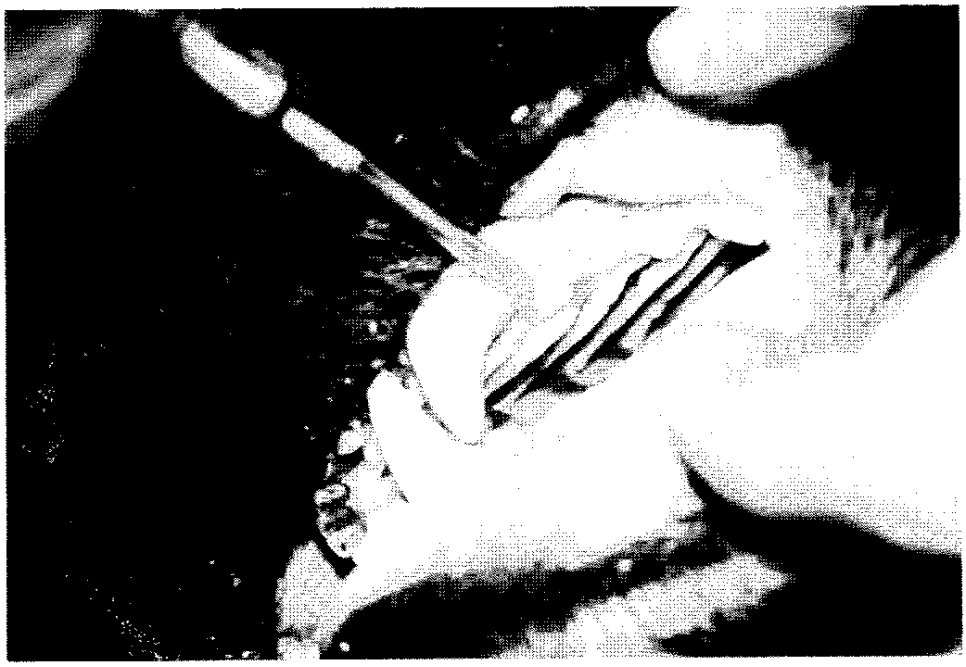

Figure 42. Removing PM 1 from a bear for aging purposes (photo by M. Burcham).

parasites and abnormalities of blood cells, analyze the chemistry of the serum and look for toxic agents, determine reproductive and physiological states, or screen enzymes to determine genetic coding. Tissue samples are taken primarily to determine genetic characteristics through electrophoresis.

When possible, blood should be taken from every bear, especially grizzlies. Considerable effort is involved in the capture of bears, therefore it is important to acquire as much data as possible, thus limiting the need to capture and handle more bears. Occasionally, blood and tissue samples should not be taken. This is especially true when the conditions are exceptionally unsanitary. Bears suffering from severe stress, trauma or infection, or bears that have a high drug tolerance should be handled and released quickly. Never endanger the bear or your own safety to collect data. Specimens should be collected early in the handling episode. Do not wait until the bear is coming out of anesthesia to collect blood and tissue.

When collecting samples, make every effort to label, store and transport the samples properly. Do not collect certain samples if refrigeration is unavailable. There is no sense in collecting samples that will be useless to lab technicians.

Coordinate with laboratories in advance as to how much and what type of blood they desire. In Montana, samples should be sent to the Montana Department of Fish, Wildlife, and Parks office in Bozeman. This state-run laboratory is screening all blood samples, compiling data, and distributing results from blood collections.

Also, a tissue bank is being developed in Bozeman for histological reference.

Blood

The easiest way to collect blood from bears is with a vacutainer. Blood can also be drawn with a syringe, but is usually more difficult. When taking blood, it is recommended that you wear rubber gloves. Although it is highly unlikely, there is always the chance of becoming infected with a virus. One of the places to take blood from a bear is from the large veins in the tongue. The veins are very visible, and the needle can be seen clearly through the vein wall when blood is being removed. Also, the enzymes in the bear's saliva will heal the needle puncture quickly.

Pull the bear's tongue out the side of its mouth and let it air dry. Screw a vacutainer needle into the holder and then insert a vacutainer tube. Using a light touch, push the vacutainer forward so that the rubber seal sticks onto the needle just enough to hold it in place. Do not puncture the rubber top or the vacutainer will loose its seal. Place the extra vacutainer tubes within reach.

Hold the dry tongue upside down and firmly in one hand, with the thumb applying pressure to the vein at the bottom of the mouth. Carefully insert the vacutainer needle at a 10 to 20 degree angle into the distended vein. Clamp down on the vacutainer holder with the pinky and ring finger of the hand holding the tongue. At the same time, push the vacutainer onto the needle with the thumb of the other hand. If needed, rotate the needle inside the vein to find the best position for drawing blood (Fig. 43). When full, remove the vacutainer and replace it with another. Be careful not to puncture the opposite side of the vein when removing and replacing vacutainers. You may have to move the needle from time to time inside the vein to keep from sucking against the vein wall.

Blood can also be removed from a vein in any leg. Put the bear on its back and loosely tie a surgical tube around the upper part of the leg. The tube will restrict the venous blood flow causing the vein to puff up. The vein can also be distended by applying pressure on the vein with a finger. Locate a spot on the leg and trim away a 2 x 2 inch patch of hair. Swab the site with sterile solution and insert the vacutainer needle into the vein with the bevelled side up. The point of the needle should be pointing towards the bear's torso. Many veterinarians and some researchers prefer to take blood from the jugular vein.

When drawing blood with a hand syringe, use the same techniques. Be careful not to pull back on the plunger too rapidly or the vein may collapse. It helps if you can operate the hand syringe with one hand. When finished, firmly rub the needle puncture for thirty seconds with your finger tips to prevent a

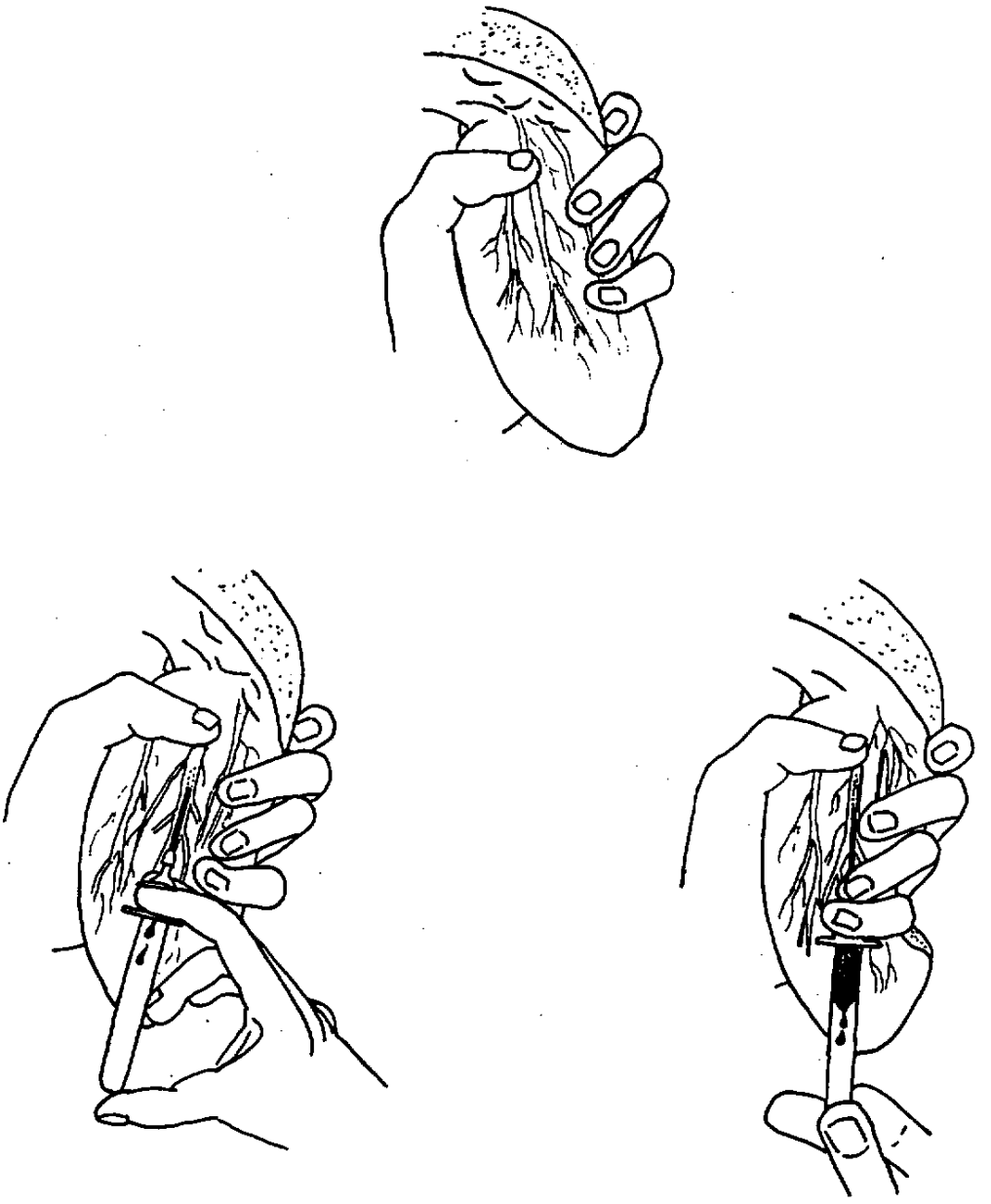

Figure 43. Taking blood from the underside of a bear's tongue.

hematoma from developing. Place the dirty needles and syringes in the hard-sided container.

When possible, fill 1 red top, 1 yellow top, and 1 purple or green top vacutainers with blood. The tubes containing anticoagulants or preservatives need to be filled at least half full with blood and then inverted to encourage mixing. If possible, take the blood sample to the lab immediately for analysis. Also make blood smears on two microscope slides before the blood cells dry and burst (Fig. 44). The smears can also be made later from blood collected in purple and green top vacutainers (Table 3.).

In the field the blood samples should be kept cool. Instant ice compresses can be placed around the vacutainers. When transporting the blood, be careful not to shake the vacutainers or the red blood cells may rupture. Store the vacutainers upright in a cool place overnight to allow them to separate. If available, the red vacutainers can be centrifuged for 15 minutes. With a pipet or syringe, draw off the serum from each vacutainer and place them in separate containers. Label all the containers. Each container should identify the bear, the date, and the vacutainer the serum was drawn from. Add an equal amount of ethylene glycol to each of the vacutainers containing the leftover clotted blood and the blood with the anticoagulant. This prevents the blood cells from bursting when the samples are frozen. Label the vacutainers and place them in a labeled envelope with the serum and put the package in the freezer. Keep the samples frozen during transport to the lab for analysis. Do <u>not</u> separate or freeze blood collected with yellow top vacutainers. Instead, keep them cool and and send them directly to the lab as soon as possible for DNA analysis (see Appendix V f or materials).

Tissue

Tissue samples can be collected by using a biopsy needle or by using a scalpel. Check the bear over carefully and look for any fresh wounds or scrapes and, if possible, take tissue from that site. On some studies, biologists save the ear plugs from the tagging procedure for later DNA analysis. The following instructions for the collection of tissue is suggested by veterinarian Connie Orr.

Place the bear on its side and trim a 2 x 1 inch section on the front medial section of the quadricep muscle. This is the front of the back leg midway between the knee and hip, an area easily reached by the bear. Care should be taken to avoid the rear portion of the back leg which contains large nerves and blood vessels. It is not necessary to shave the site.

Swab the trimmed site with a sterile solution. Insert the biopsy needle and remove a piece of muscle, or make a 1 1/2- to

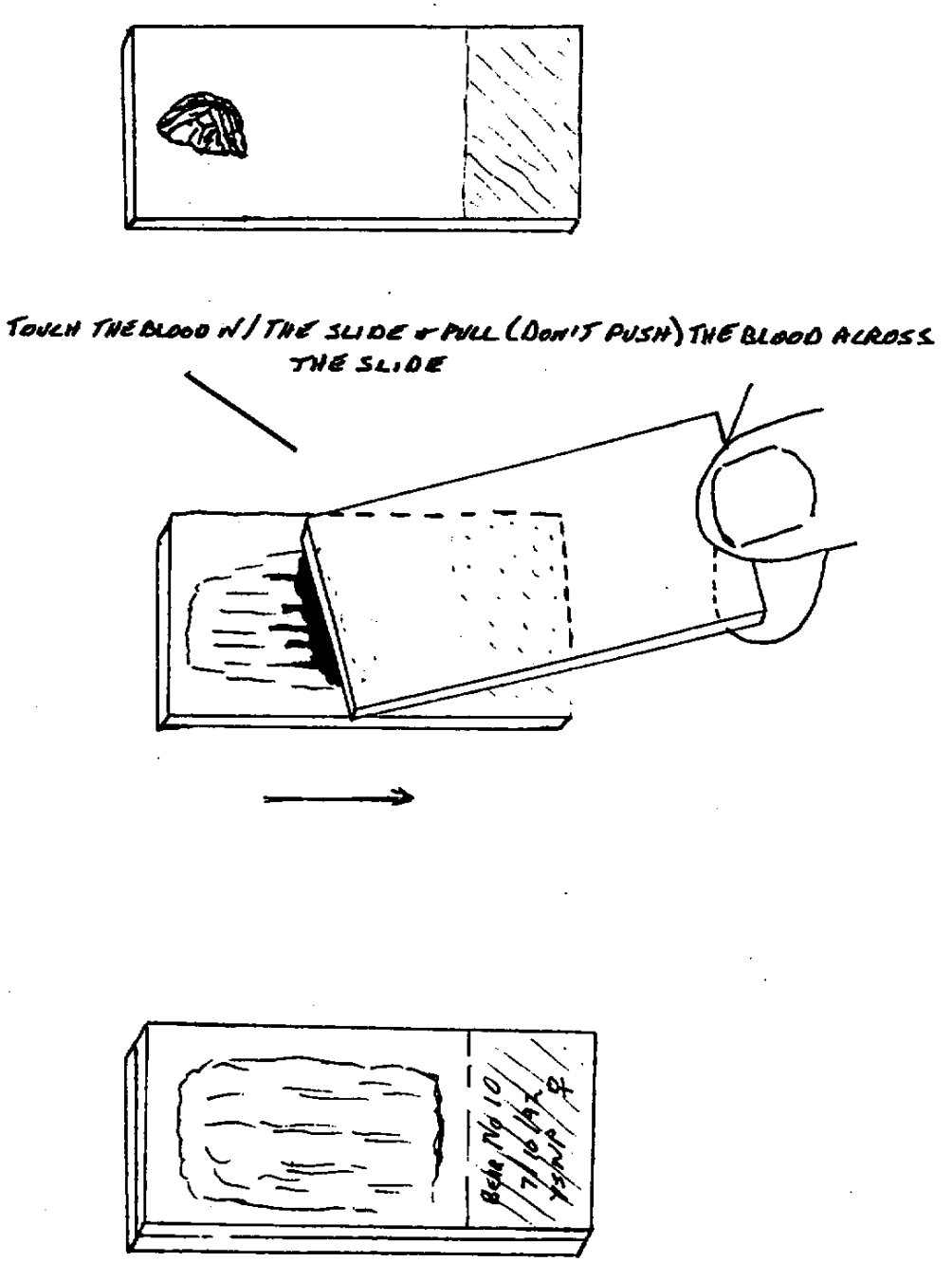

Figure 44. Making a blood smear.

Table 3. Color of vacutainer tops, their contents, and normal uses.

Color of Top	Contents	Normal Uses
Red	- Nothing	- Clotting tube to examine blood chemistry, disease serology, and DNA analysis.
Green	- Heparine (anticoagulant)	- For testing the presence of lead and other toxins.
Purple	- EDTA (anticoagulant)	- Hematology
Yellow	- ACD (preservative)	- Molecular genetics for both nuclear and mitochondrial DNA

2-inch vertical incision through the skin with a scalpel. Reach in with a hemostat and pick up a small band of muscle. Sever a piece 1 inch long and 1/8 inch wide and place it in a small plastic container. Treat the wound with Furazol powder and then leave alone. The wound will stop bleeding shortly and will heal rapidly. The bear can be given an intramuscular injection of antibiotic to guard against infection.

The tissue sample should be labeled with the date, location, sex, estimated age, and number of the bear. The sample should be frozen immediately or wrapped in an Instant Ice pack until it can be frozen (see Appendix V for materials).

Urine

If needed, urine can be collected for trapping lure or analysis with a dicapheter, but it is difficult. Lasix, a diuretic available in 50 mg/ml concentration, promotes the excretion of urine, and is recommended for use in bears. This drug has a wide dosage range, but 1 cc/100 pounds IV or IM is recommended (Orr 1988). Lasix does draw fluids out of other body compartments, which will dilute the urine sample. Lasix takes about 15-20 minutes to take effect. The use of a diuretic, however, does not affect the ability to diagnose infections or register chemistry makeup and hormone levels. The urine should be frozen and sent to a lab for analysis as soon as possible.

Saliva

Several years ago the California Criminal Investigations Lab requested that bear researchers as well as other wildlife researchers in Montana take saliva samples on trapped animals. The crime lab was compiling data for future investigations in animal-related human deaths. The lab was hoping to accumulate enough samples to create a species identification chart by characterizing the parameters of body fluids in various wildlife species. In humans, 80% of the population excrete enzymes into their urine, saliva and other body fluids, allowing investigators to determine their blood type (A, B and O substances.) The only way to determine the blood type of the rest of the human population is to analyze their blood characters. The crime lab wanted to see if this was the case with bears as well.

Hair

Hair should be pulled from a variety of sites on the bear, such as the back, ribs, arm pit, and head. It is important to get both the hair and the root follicle. Slower growing hairs, such as eyebrow hair, carry the most information. Place the hair samples in separate labeled envelopes.

Drug residues become combined with various proteins and antibodies manufactured by the body. Traces of drug residues can be documented in the growing cortex, an inner layer of the hair. Contaminants ingested by bears can also be identified in hair. Mercury levels, for example, can be measured and studied in bear populations that eat large amounts of spawning salmon. There are still limitations, but advances in the radioimmunoassay of hair is opening up many new areas of research (Williams 1988).

Genetic research is also being conducted with bundles of DNA removed from hair (Picton and Knight 1980). For genetics work, care must be taken to avoid contaminating the collected hair samples with any other tissue. If pliers are used to obtain a sample of hair follicles, always clean the jaws of any debris to prevent cross contamination.

Milk

If a female bear is lactating, you may want to take a milk sample to document toxic chemicals and drug residues. If needed, an IM shot of Oxytocin can be given to the bear to induce milk flow. Collect 10 cc's of milk and store in a cool place. Centrifuge the milk sample and separate the clabber from the casein (casein will be at bottom.) Label and freeze the samples.

Standard Measurements

Body measurements are easy to record, but are time-consuming and should be gathered toward the end of the handling episode. More important handling procedures should be completed first. Measurements are valuable for determining growth rates, comparing populations, and documenting the individual bear's characteristics for future identification (Table 4).

Reproductive Data

The sex of every captured bear, especially if it is going to be relocated, should be determined. The last thing you want to do is relocate a female bear that has cubs or yearlings. Usually the only way to determine the presence of cubs is if the female is lactating. After July, however, females may no longer produce milk in any quantity. If you think the bear may have offspring, check the surrounding area carefully. Look for smaller tracks and scats. If there is any doubt, you may need to leave the site and observe it from a distance. Disturb some ground around the trapped bear and come back later to look for tracks. If you are unable to capture the cubs, then release the mother on-site.

Table 4. Standard measurements taken on bears.

1) Neck circumference - measured at the smallest point of the neck.

2) Chest circumference - measured just behind the shoulders.

3) Shoulder Height - measured with the bear lying on its side. This is the distance from the heel of the front foot to the top of the shoulder blade, following the contour of the leg.

4) Total length - the distance from the tip of the nose to the tip of the tail, following the dorsal contours.

5) Front and hind foot length and width - do not include claws when measuring length.

Female bears with small, pink nipples have not yet reproduced. If the bear's nipples are large and brown or grey, they have reproduced and there may be cubs or yearlings at the site. Measure the length and width of the nipples. The data may be useful for documenting changes in the breeding age of the population and past reproduction (Kasworm and Manley 1988, Aune and Kasworm 1989).

Make a note if the female is in estrus. The vulva will be swollen and pink during the breeding season. Document any lesions or sores. (The urine of females in estrus makes an excellent base for a trapping lure.) If a male is an active breeder, its testes will be large and descended.

Documenting Parasites and Diseases

Bears are remarkably free of infectious diseases, but both external and internal parasites may be found on bears (Worely et al. 1974). Check the bear over carefully for skin parasites by looking through the hair, between the toes, around the ears and in the armpits. External parasites such as fleas, lice, and mites should be collected and stored in alcohol or frozen. Microscopic skin mites may occasionally cause the loss of hair around the eyes and nose.

Any diseases or physical ailments should be documented. Great care should be taken however, when measuring, photographing, or sampling any growths or lesions. Pathogens potentially dangerous to humans are harbored in all animals. The oldest documented case of syphilis, for example, has been tentatively traced to a bear that lived 11,500 years ago, 5,000 years before there was a clear outbreak in man (McAuliffe 1990). Cancerous growths, cataracts, and eye deformities have been reported in bears by the IGBST. Clostridium infections, Staphylococcus septicemia, and purulent meningitis have been documented in bears (Wallach 1986).

Internal parasites are difficult to document in live bears. Ascarides, ursid hookworm, trichinosis, tapeworms, and flukes have been reported in bears. When internal parasites are observed in the stool or rectum, they should be collected and frozen or placed in alcohol.

Estimating the Age of a Bear by Tooth Wear

The most reliable method for aging bears requires that a small tooth be removed and the cementum layer examined microscopically in a lab. An approximate age estimate can be determined in the field by examining the bear's dentition (Palmisciano 1988, LeCount 1986).

Tooth wear is variable with each bear due to genetics and the variety of food sources and habitats that grizzlies use. Malnutrition can also play a part in tooth condition. For example, a three year-old female grizzly that was orphaned as a cub in the Yellowstone ecosystem had malformed dentition and stunted body

growth. It can be theorized that grizzlies living in dry, rocky regions, where much of their food consists of roots and tubers, will have teeth with greater wear because of abrasive soils mixed in with their food. It should also be noted that bears in heavily managed ecosystems, such as the Yellowstone region, will have a higher incidence of broken and damaged teeth from injuries acquired while trying to escape from culvert traps. Teeth will also be damaged from natural feeding practices, injuries, and fighting.

If there is any question as to the species of the bear, measure the length of the last upper molar (M2). In black bears, the last upper molar will be less than 1 1/8 inches (28 mm) long (Fig. 45).

Cubs of the year will always have deciduous teeth and permanent teeth in various stages of eruption. In May and June, the molars are not yet present and the middle permanent incisors (I1) may be starting to erupt. The canines will be deciduous. By July and August molar 1 and incisor 1 will be nearly erupted and incisor 2's tips (2nd incisors from the canine) will be visible in the gums (Fig. 46).

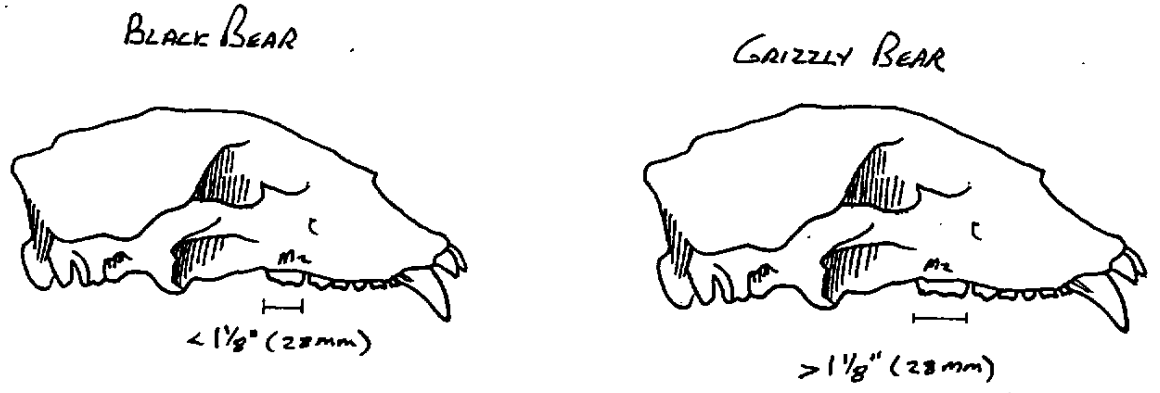

Figure 45. Differentiating black bear and grizzly skulls by measuring the length of upper M2 (drawing by N. Wiegert).

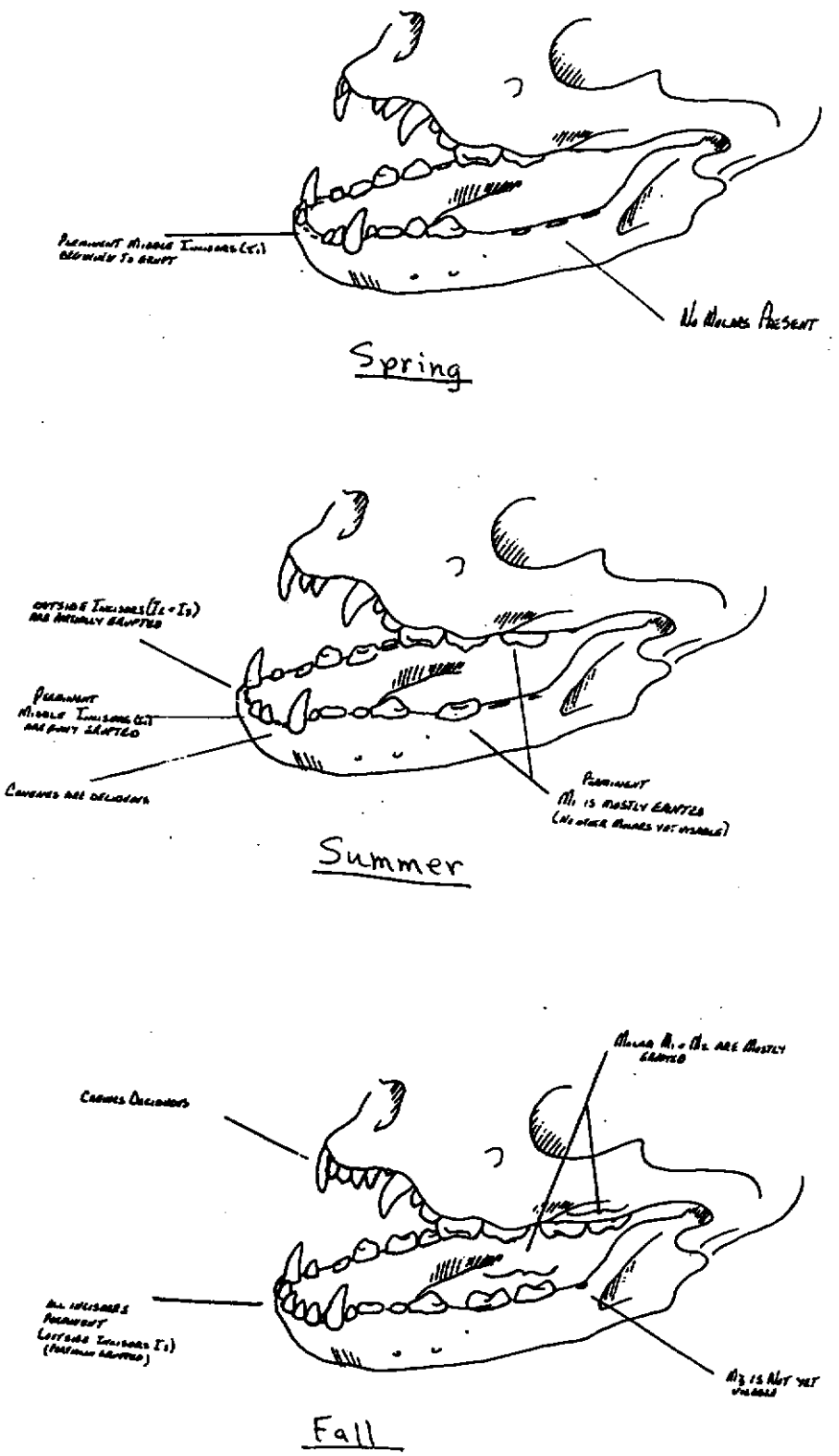

Figure 46. Dentition characteristics of bears < 1 yr. old (drawings by N. Wiegert).

In the fall, a cub's body size may confuse the handler into thinking it is a sub-adult. The dentition, however, is fairly distinct. The canines will be deciduous or just starting to erupt. Molars 1 and 2 and all the incisors will be mostly erupted, but Molar 3 (lower jaw) will be absent or barely visible (Palmisciano 1988).

In the spring, a yearling will have all of its permanent teeth showing, but the canines and third molar will only be partially erupted. The best gauge is the canine, which will be 1/8 to 1/2 erupted. By mid summer the lower third molar will have mostly grown in, and the canine will be 1/2 to 3/4 erupted. In the fall, all the teeth will be smooth, unworn and the canine will be up to 7/8 erupted (Fig. 47).

To estimate a bear's age after the first year, one must pay attention to the condition and color of the canines and incisors. Over the years the permanent teeth will yellow, wear flat or round, crack, split and break completely off (Fig. 48).

Two to 4-year old bears will have smooth and mostly white teeth, and the canine tips and incisors will be starting to square off. Cusps will still be visible.

Five to 6-year old bears will have flattened canine tips, and all the incisors will be worn flat. The middle incisors will still have cusps with dentine spots showing in the center, and most of the teeth will be stained yellow.

Seven to 10-year old bears will have flattened, yellowed canines with some hair-line cracks. All the incisors will be worn flat with the two lower middle incisors showing more wear.

Eleven to 15-year old bears will have discolored, flattened, cracked and/or recently broken canines. The incisors will be just above gum line and worn straight across. The two lower middle incisors will be more worn and slightly rounded or broken.

By the age of 15, most grizzly bears have extremely worn, discolored and broken front teeth. The molars are still intact with slight wear, but heavily stained with dark yellow and brown hues. One or more of the canines is usually broken and rounded smooth at the gum line. The remaining canines are often cracked or splintered. All the incisors are usually worn straight across at the gums. The lower incisors will have rounded crowns (Palmisciano 1988) with stained layers of dentine visible. Quite often several will be missing.

Even though their dentition is inferior, bears 15 and older, especially males, are often large and quite healthy. The oldest grizzly captured and handled in Montana was a 32-year old female in the Cabinet Mountains. Her teeth were broken and the incisors worn down to the gum line, but her body condition was still good (Kasworm and Manley 1988). Senior bears probably have more trouble than younger animals when it comes to nipping, shearing and grinding up food. This is probably compensated by the older bears' efficiency in finding food and superior feeding techniques. At some point, however, tooth damage will become so

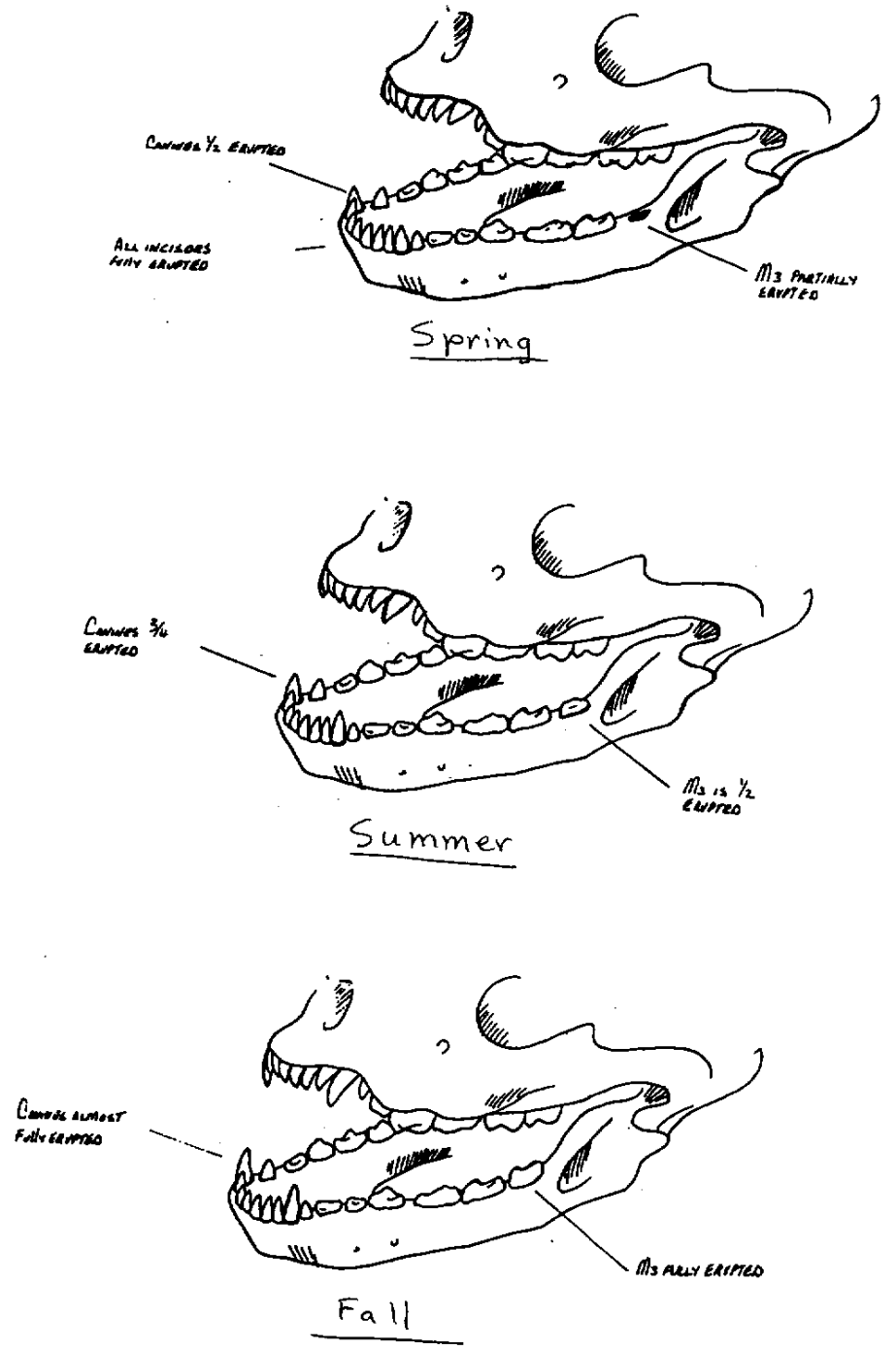

Figure 47. Dentition characteristics of bears 1.0 to 2.0 years old (drawings by N. Wiegert).

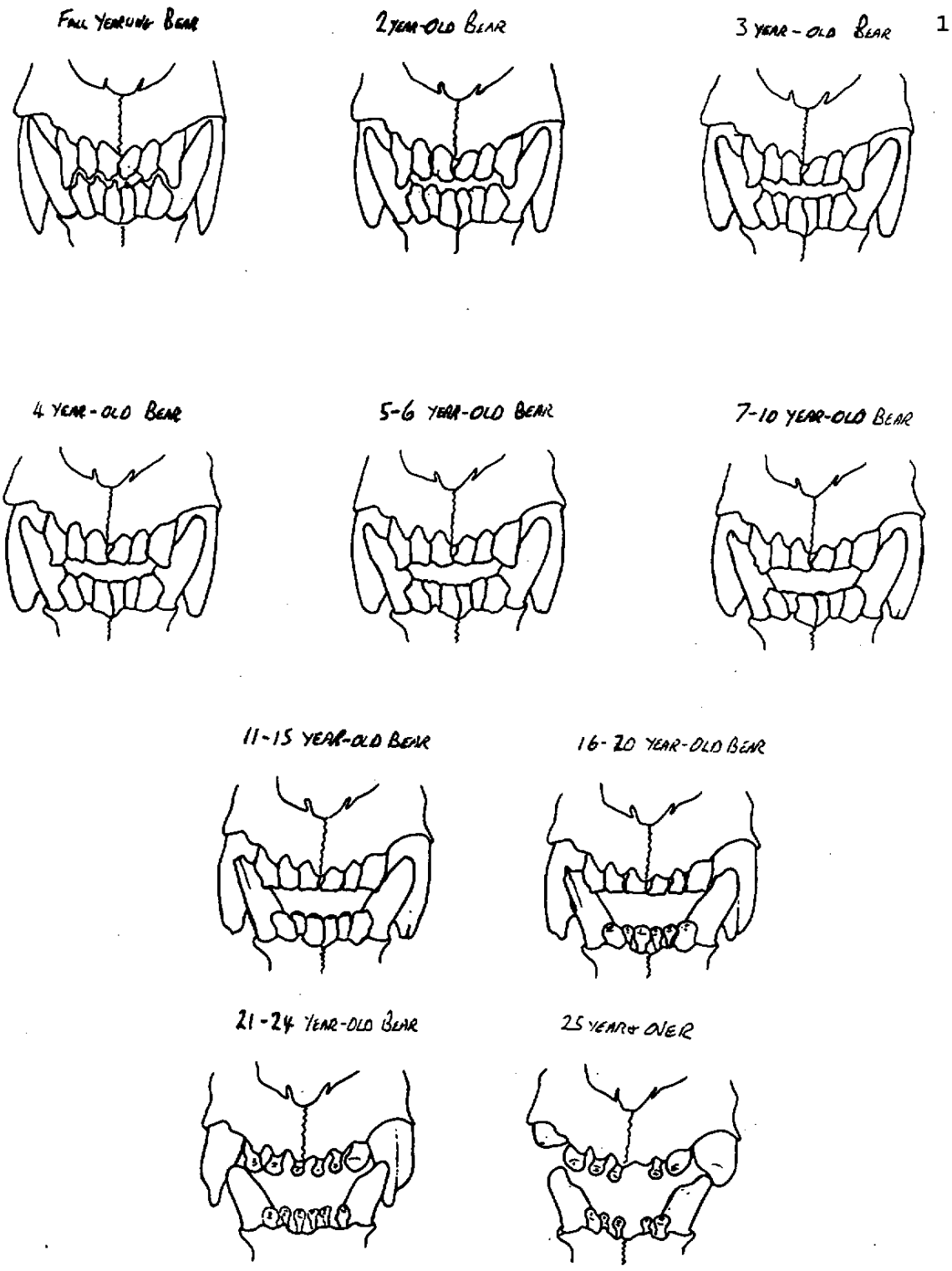

Figure 48. Dentition characteristics of bears of various ages (drawings by N. Wiegert).

severe that the animal will no longer be able to feed effectively. Therefore, in a sense, a bear's natural life span is regulated by the condition of its teeth.

Bear Condition

Write down a detailed description of the bear's general body condition. Comment on any wounds or ailments. Bears are normally in good condition in the early spring when they emerge from the den. Through April and until midsummer, they usually lose weight. As the summer progresses into the late fall, they will steadily increase in weight. Sick, injured, and young bears and sometimes females with cubs of the year will be in poor condition at any time of the year. To evaluate body condition, the bear should be felt with the hands. Some studies use a numerical rating, where 1 = emaciated, 3 = average, and 5 = obese. LeCount (1986), recommends the following criteria:

Poor - Hip bones, shoulder blades, backbone and ribs can be easily felt. Bear appears to be a skeleton with skin stretched over it and looks unhealthy.

Fair - Hip bones, shoulder blades, backbone and ribs can be felt but are not prominent. Bear appears thin but not unhealthy.

Good - Hip bones, shoulder blades, backbone, and ribs are difficult to feel. Bear appears healthy but not extremely fat.

Excellent - No bones can be felt. Bear appears extremely fat and healthy.

Bear Descriptions

Each bear is an individual and should be described on the capture form in detail. Make comments on the animal's coloration, dentition, head profile, and any distinguishing marking or scars. The pelt should be described in such a way that the bear can be identified from a distance. Any cracked, chipped or missing teeth should be noted in case the bear is caught again in the future without ear tags. Every bear has a different head shape. Some bears, for example, have long narrow noses, while other bears have broad short noses. Any ear notches, facial scars or old wounds on the body should be described and if possible, photographed.

Preparing for Bear Recovery

Plan ahead for the animal's recovery. When the handling procedures are completed, pack up the equipment and specimens. Test the bear's depth of anesthesia. When the animal responds to stimulus, remove the safety snare and leave the site immediately. If the bear is still deeply immobilized, remove the snare and place the bear in a shaded site that is visible from at least 100 yards. Cover the animal's eyes and if it is hot and humid, place the bear in a position of sternal recumbency with the femoral region against the cool soil. In cold weather, place the bear on an insulated surface of boughs or an ensolite pad. If the bear is to be moved to another site in a culvert trap, it should be placed in the trap before it starts to revive. When a bear needs to be aroused with an antagonist, the equipment should first be returned to the truck or a safe distance up the trail. When ready, the bear can be given an IM injection. If the bear needs to be revived immediately, give the injection IV. Leave the site and monitor the bear's recovery from a safe distance, preferably from within a closed vehicle.

When possible, remain near the site in a vehicle until the bear revives. If there is any chance that another bear might come into the site, be prepared to stay near the downed bear until it can move off. Never become impatient and attempt to force a drugged bear to get up. Too many bear researchers have become restless and approached a sleeping grizzly only to be charged, thus endangering not only their life but also the bear's. A bear recovering from anesthesia is possibly the most dangerous aspect of handling bears, especially when using Ketamine and Rompun. As soon as the bear is able to pick up its head, start up your truck and leave the area. Record the time and recovery reactions. If the bear is to be relocated to another site in a culvert trap, it is best if the bear is fully revived from the drug prior to transport.

TRANSPORTING AND RELEASING BEARS

Transporting Bears in Culvert Traps

When a bear is to be transported in a culvert trap to a different site with a truck, it is important to keep the trap padlocked to prevent the animal from escaping by its own dexterity, or by the aid of a concerned individual. If the weather is not too warm, both ends of the trap should be sealed with a tarp to prevent people from peering in and to reduce stress caused by traffic, movement and noise. At no time should large crowds be allowed to form around the trap. A culvert trap with a bear inside should be pulled behind a truck like a horse trailer. The driver should avoid any sudden stops or bursts of speed. The ride for the bear should be as smooth as possible. When possible, the back roads should be driven to avoid heavy traffic, communities, and residential areas. Travelling in the early morning or after dark also avoids attention. It is advisable to have another vehicle following the towing unit to aid in confrontations and to control traffic.

On long trips the animal should be watered and fed regularly and provided with sufficient ventilation. Blocks of ice can be placed in the trap as a source of water and to aid in thermal regulation. In cold weather the bear should be supplied with bedding material. If the bear must remain in a parked trap for more than a half hour, it should be attended and the trap should be parked in the shade away from crowds. If possible, the trap should be locked in a darkened and well-ventilated garage. In the wild, bears avoid contact with their own feces and urine; therefore, the bear and culvert trap should be cleaned with a hose regularly.

If the bear being transported is under the effects of a drug, stop periodically to make sure the animal is able to breath properly. Occasionally, the bear will get bounced around, and its nose will be pushed into a corner, causing suffocation. When hauling traps with high-clearance vehicles, make sure drugged bears are placed with their body lying uphill. Some trucks, especially diesels, have exhaust systems that will pollute the inside of a culvert trap, and therefore should not be used.

Recently transported bears are poor drugging risks, especially after a long journey. If possible, allow the animal to calm down in a quiet area before carrying out any drugging. Being transported in a culvert trap is a very stressful event for most bears.

When family groups are hauled in one trap, especially sub-adults, fighting will sometimes occur. Most of the time the bears will work it out after some biting and scratching, but occasionally the fight will have to be broken up with a bucket of water. If the bears refuse to stop fighting or show signs of severe stress, a tranquilizer can be administered. When possible, adult and sub-adult bears should be hauled in separate traps.

The safest way to separate two bears in a culvert trap or to

put one bear in another trap is to induce anesthesia. Two traps can also be placed door to door and clamped together with large "C" clamps. The two traps should be on the same level, the doors should match, and there should be no openings larger than a paw. Open the two trap doors, tie a cord to the trigger devices and wait patiently one of the bears to move into the other trap. When the bear enters the other trap, pull the cord and trip the door. You may have to cover the end of the trap you want the bear to enter, and scare the bear toward the darkened end.

Transporting Bears By Helicopter

When bears are being moved to another site with a helicopter, it is best to keep the bear in the culvert trap. Tie a bag of rocks or a weight onto the back of the trap to keep the cargo from spinning in the air (Fig. 49). In emergency situations, the bear can be hauled in a helicopter sling net. Place a sheet of plywood in the net first and then place the bear on top of the plywood. The bear should be fully drugged, and extra drugs should be available for the trip. When a bear is hauled in a sling net, it should also be wrapped in a tarp to prevent the head and legs from protruding out of the net. The bear's head should be covered in the tarp to prevent the bear from suffocating in the cold wind. Occasionally, when the bear is small and the relocation site is near, the animal can be immobilized, blindfolded, hobbled, and transported to the site in the back of a pickup truck or the cargo rack of a helicopter.

Releasing Bears From Culvert Traps

There are only a few safe ways to release grizzly bears from culvert traps. Bears are strong and fast, and any attempts to release one when there is a chance of bear/human contact is an act of foolishness. Too many bears have been killed, and too many people injured from poorly planned bear releases. In 1988, for example, two bear managers were injured in separate incidents. In both cases the men were visible and available to the bear upon release.

Most bears are released at areas accessible by vehicle. The release site should be remote and a safe distance from hiking trails and campgrounds. Only two to four people and one or two trucks should be present. Too many people and too much noise create unneeded stress for the bear. It is recommended that each vehicle contain a firearm and a radio.

Most culvert traps have door frames that can be used as an anchor point when pulling doors up. (Occasionally a stout tripod

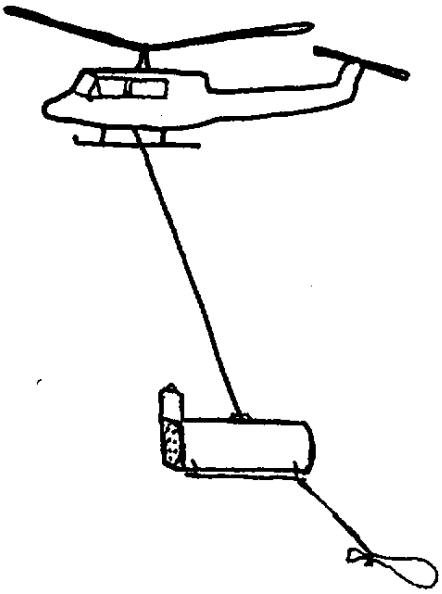

Figure 49. Transporting bears with a helicopter. A bag of rocks tied to the rear of the trap will help prevent it from spinning.

or tree limb, rigged with a pulley, must be positioned above the door.) Unhitch the culvert trap from the truck and block both wheels. Tie one end of a 100-foot, 1/2-inch diameter rope to the bottom of the door. Run the rope over the top of the door frame and pull it to its full length to the truck, which should be pointing back down the road in the opposite direction of the trap door. The trap door should be facing dense cover and angling downhill.

When only two people are present, the driver or the passenger should tie a knot in the end of the rope, bring it into the cab, and close the door on the rope. The other person, armed and ready, will unlock the door on signal and prepare the door spring locking mechanism. When both people are in the vehicle, the driver can pull forward and lift the door. As soon as the bear leaves the trap or when the door locks into the "open" position, the driver should release the rope from the door and quickly leave the immediate vicinity. It is the passenger's responsibility to keep an eye on the bear and instruct the driver (Fig. 50). If the bear refuses to leave the trap, make sure the door is locked in the open position and observe the site from a distance. The bear will leave eventually. When more people are available, another truck, with a planned escape route, can be kept idling a safe distance away to monitor the situation. Should a problem with the bear arise, they can come to the aid of the other vehicle. One passenger should be armed with a rifle and have a clear shooting position.

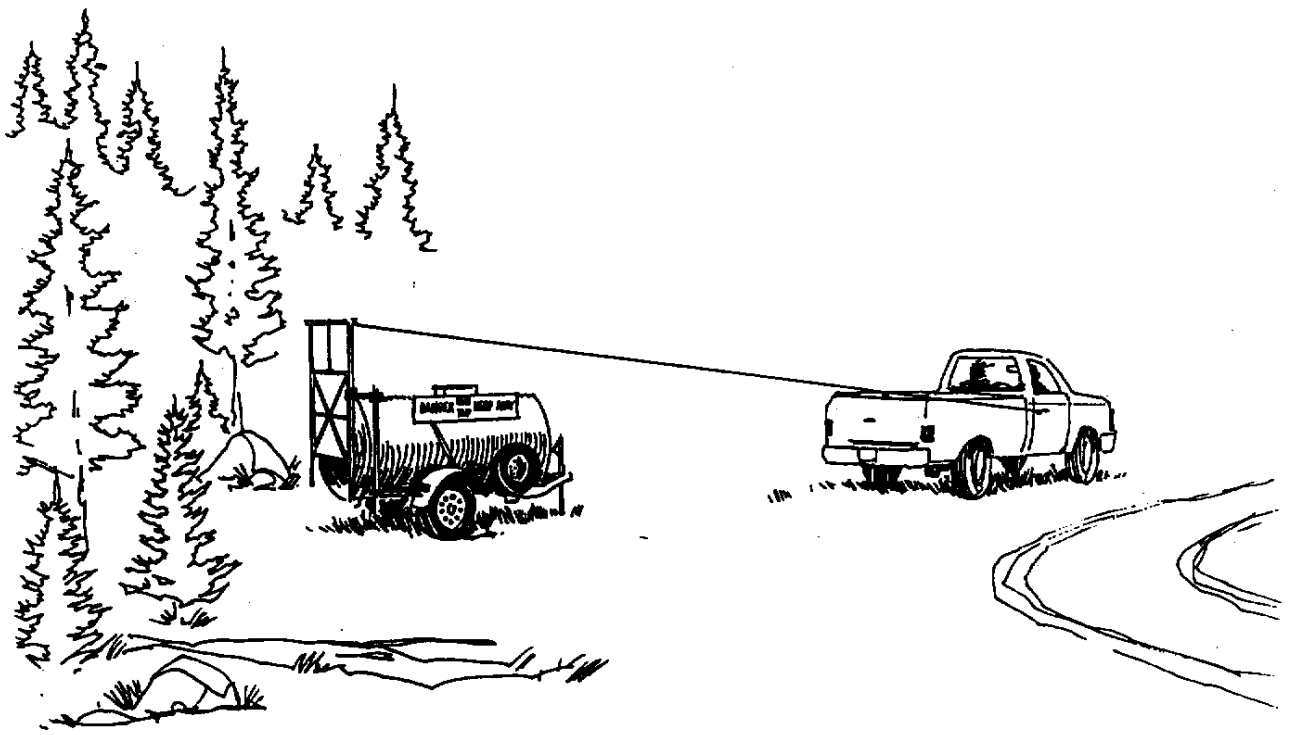

Figure 50. Releasing a bear from a culvert trap (drawing by N. Wiegert).

In Canada, polar bears are released by backing the culvert trap against the brick wall of an abandoned building. With the back of the trap flush against the wall, the door of the trap can be safely pulled up by hand and locked in the "open" position. With everyone back inside the vehicle, they simply pull the truck and trap forward a few feet to allow the bear to climb out.

When bears are released, everyone should be in a vehicle and not obvious to the bear. The trap should be positioned so the bear can see a route toward cover. When releasing family groups, make sure all the bears are fully recovered from anesthesia and that the traps are angled toward each other so that the bears are aware of each other's presence. Attempt to lift the doors simultaneously, and then leave the site. A female could become separated from her cubs after being relocated if she is still under the effects of immobilization, or the cubs may leave the site unaware that their mother or sibling is in another trap.

When bears are released from culvert traps in the backcountry, they should be immobilized unless there is a helicopter. When a helicopter is available, the trap door can be pulled up with a rope attached to the chopper. In rare instances, a bear can be released from a backcountry trap with a very long rope, but it is not recommended. If this method is used, all individuals should be armed and in the safety of a tree or on horseback.

Some bears will refuse to leave an opened culvert trap, which is why it is recommended that the trap be angling downhill. If nothing else, the bear will slide out when the door is opened. The alternatives are to attempt to frighten the bear out of the trap by honking the truck horn or leaving the site and coming back later for the trap. Even black bears should not be released by an individual standing on top of the trap, and no photographer should be outside of a vehicle. Upon release, grizzly bears have been known to attack the first thing in sight, to chase vehicles down the road, and to attempt to climb into the backs of trucks. There are some culvert trap designs that can be opened electronically from a distance with a remote or with a winch, but unless they are maintained, they are not reliable.

IN SUMMARY

In the past, bounty hunters using dogs, jawed traps, spiked wooden head-barrels, dead falls, pit traps, poison, and set guns roamed the Rocky Mountains and the Great Plains in search of bears. Bears are still being trapped, but the object is to capture them without harm in order to preserve and better manage the species. Some accidents and deaths cannot be helped when trapping and handling bears. The point that always comes to mind first is that the bear would be alive or uninjured if the capture effort had not been attempted. That is why it is so important to exercise care, and to document every aspect of every capture. If something goes wrong, you can later determine how to prevent a similar mistake from being made in the future. Sometimes the best techniques are developed by analyzing how things went wrong in the past. Communication is the most valuable tool in bear research and management.

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APPENDIX I.

TROUBLE SHOOTING

Treating Anesthetic Emergencies

Convulsions

The first aid kit should contain everything needed to treat anesthetic emergencies. Convulsions are caused by a lack of oxygen to the vascular system and muscles. Symptoms of convulsions include muscle rigidity followed by spastic movements which may become violent. Vasoconstriction is a common side effect in bears drugged with Sernylan and is best treated by the delivery of additional Acepromazine or Sparine. Mild convulsions have also been reported in bears drugged with Telazol and Ketamine/Rompun. To keep the animal from hurting itself during seizures, it should be wrapped in a tarp. Keep quiet and remove any sharp objects from around the bear. Hold the animal's head securely and be careful to protect its eyes until the convulsions stop. If the convulsions become progressively worse, administer Dopram (Orr pers. comm.).

Overheating and Hypothermia

If the bear's temperature continues to rise above 104 degrees, it should be cooled down immediately. Pour water over the animal and keep its chest, abdomen and femoral triangle pressed against the cool soil. If possible, carry the bear to a pond or stream and submerge all but its head in the water. In emergency situations, the bear can be given a cold water enema (Johnson pers. comm.). At least 5 gallons of water should be available in a vehicle at all times. In the summer as a standard procedure, dampen every bear when the weather is warm and the bear is showing any symptoms of heat stress such as panting. In cold weather, the bear should be routinely wrapped in a space blanket or placed on an ensolite pad. In emergency situations, the bear's temperature can be raised by building a fire at the working site or by placing non-toxic chemical heating pads under the bear's "armpits".

Vomiting

A bear should always be positioned slightly downhill in case it vomits during anesthesia. If any liquid enters the lungs, the bear could suffocate or later die of pneumonia. If a bear regurgitates, clear the mouth and open the airway. If necessary, pull the bear up by its hind legs to help drain the vomit.

Respiratory Distress

If a bear stops breathing or is showing signs of respiratory distress, it should be given a shot of the drug's antagonist. The recommended antagonists for Telazol (Dopram) and Ketamine/Rompun (Yohimbine) will reverse some of the ill affects caused by the drug mixtures. The bear should also be given a shot of Dopram (a potent respiratory stimulant) at a dose of about 5 ml/100 pounds. If breathing has ceased, perform artificial respiration in addition to the Dopram injection.

By using either the mouth to nose or endotracheal catheter method of artificial respiration, a bear could theoretically be kept alive until the natural breathing processes return. Both of these techniques are superior to manual artificial resuscitation.

A rubber aspirator tube with an inflatable collar, approximately 65 cm long, and 30 mm wide, should be kept in the drug kit. Ideally, two more tubes, slightly wider and narrower to accommodate different bear larynx sizes, should also be included. The snugger the aspirator tube's fit, the more effective the procedure. Endotracheal tubes can be ordered through any veterinarian. Lightweight resuscitation bags with nose cones or endotracheal tubes are also available.

To perform artificial respiration:

1. Place the bear on its right side. Pull the head and neck forward to straighten the airway. Open the bear's mouth and make sure the tongue is pulled forward and not blocking the throat. Lay the head on the ground and clean away any dirt on the nose.

2. If there is a pulse but no breathing, provide one ventilation every five heart beats. (If there is no heart beat, see section on Cardiac Arrest.) For the mouth to nose method, close the bear's mouth tightly and lift the snout slightly. Open your mouth wide, take a deep breath, seal your mouth tightly over the bear's nose and blow into the nostrils. If the airway is not impaired, the bear will naturally exhale when you momentarily remove your mouth for another breath. Continue until the bear resumes breathing.

3. If the animal's nose is too large for the mouth to nose method, an aspirator tube can be placed down the throat. After applying a sterile jell to the chosen aspirator tube to prevent irritation of the throat, grasp the bear's tongue and pull it forward; this brings the larynx into the pharynx a short distance. With the aid of a flashlight, extend the index finger into the mouth and depress the epiglottis. With the other hand, guide the tip of the tube along the index finger into the laryngeal canal. It should only be inserted three to four inches. Next, inflate the collar to expand the bottom of the tube to prevent air from escaping and to insure a snug fit against the larynx wall (Fig. 51). Using the same techniques as above, begin artificial respiration.

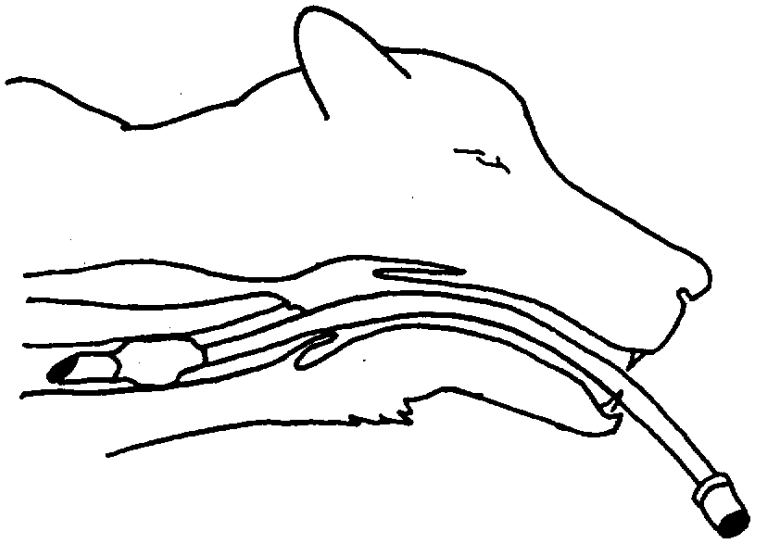


Figure 51. Positioning an aspirator tube in a bear's trachea.

To perform manual resuscitation, place the animal on its side and with the head slightly downhill. Grasp the hide with both hands in the center of the ribs, and begin pressing and lifting 10-15 times a minute. Listen for the inhalation and exhalation of air. It should be quite audible if properly done. Be aware that this technique may result in the accidental inhalation of liquids or vomit.

If a bear fails to revive after an extended period of time, it is pointless to continue. Brain tissue is very sensitive to the lack of oxygen. Once the heart and lungs have been shut down for more than 10 minutes, the brain is probably permanently damaged.

A bear that has suffered from a mild case of hypoxia will take hours, sometimes days to recover. In cases like this, the animal should be left alone to sleep it off. It is suggested that the bear be observed from a distance or checked on regularly to prevent harassment from other bears. Lumb (1963) reports that if an animal suffering from hypoxia has not regained consciousness within 72 hours, it will probably die.

Cardiac Arrest

If a bear's heart stops beating, immediately inject 5 ml of Dopram per 100 pounds of bear IV under the tongue. If the bear fails to respond, then inject several ml of the stimulant directly into the heart. The heart is located on the left side between the fourth and fifth rib where the chest meets the elbow. Using one

hand, locate the heart, massage the site, and then inject 2-3 ml of Dopram directly into the heart muscle with a 2 to 3 inch needle (Orr pers. comm).

To administer CPR to a bear, place the animal on its right side and insert the aspirator tube or prepare for the mouth to nose method of artificial respiration and give the bear two quick breaths. Next, straddle the bear's front legs, gather up two handfuls of muscle and hair at the armpit and pull up and back so the chest cavity opens up. Allowing your arms to remain rigid, open your hands and roll forward. Your hands should be over the heart and flat against the ribs. Compress the chest 1 1/2 to 2 inches. If only one person is applying CPR, the American Red Cross recommends 80 chest compressions per minute for humans, with two quick breaths every 15 compressions. CPR with two people requires 60 chest compressions per minute with one ventilation every five compressions. The same technique can be applied to bears.

Treating Major Injuries

Open Wounds

Bears are tough and will usually recover from injuries without assistance. However, it is still recommended that everything possible be done to help the bear. Never be too quick to kill a bear for humane reasons because it is injured. Bears have amazing healing abilities and will often recover from what appear to be life-threatening injuries. Occasionally, however, a bear will have to be destroyed.

Veterinarian Connie Orr, of Missoula, Montana, suggests that the hair be clipped around all wounds, snare-related cuts, injection sites, ear tags, tissue and blood sample sites, and collar-related abrasions. Deep wounds should be thoroughly flushed with a syringe filled with a weak Betadine or Nolvasan solution, and then left to drain and heal in the open air. Any bleeding should be controlled immediately. Apply direct pressure to the wound or the pressure points. If blood flow needs to be stopped immediately, the wound can be cauterized with a blow torch or a hot brand (Haroldson pers. comm.). Severe wounds should be cleaned, sterilized, and sutured (if needed). The use of alcohol or hydrogen peroxide is not recommended. A deep wound cleansed with these products (which kill protein), has a harder time healing and is more prone to infection because of the resulting tissue damage.

When a bear has a severely infected wound it should be cleaned thoroughly. Some of the worst infections have been documented in male bears during the breeding season. Trim the hair away from the wound and flush away any maggots or puss using soap and water or a syringe filled with a weak Betadine or Nolvasan solution. Maggots will eat dead tissue, but they also perpetuate their environment and should be removed. Deep puncture wounds and gashes should be flushed until they are completely free of dead tissue. Cut away rotten flesh, but be careful not to damage any nerves or muscles

(Levesque pers. comm). You want to encourage the wound to drain freely and heal from the inside out (see Appendix V for materials).

Broken Bones and Teeth

In compound fractures, treat the open wound. Set the bones and remove any bone splinters. If blood loss is excessive, apply direct pressure to the wound and/or pressure points. As a last resort, a tourniquet can be used to stop the blood flow. Do not leave the tourniquet on too long. Never apply bandages or splints. A wild animal should not be released with a bandage (Johnson pers. comm.). The leg should be folded up against the body in such a way that when the leg swells, it will be tucked up high and out of the bear's way. Natural swelling will keep the limb from moving. In extremely serious breaks where the leg is being held together by a piece of skin or muscle, it is best to remove the limb. Leave a flap of skin that you can sew over the stump (Levesque pers. comm.).

Bears captured in poorly designed culvert traps are prone to breaking teeth and injuring their jaws. Splintered and broken teeth that are barely hanging onto the gums should be removed. Broken canines hanging off to the side of the mouth should also be removed. Bears with broken jaws or noses should not be destroyed unless the injury is so severe that the animal will be unable to eat after the bones knit. In severe jaw breaks, reposition the broken bones and let the tissue swell. Wild bears have survived very severe jaw and snout injuries. When possible, take the bear to a veterinarian for treatment and keep the bear in captivity until the injury heals (Fig. 52).

Dart Enters The Body Cavity

A bear shot in the body cavity with a Cap-Chur dart will often appear healthy, but if the bear was standing with its legs wide spread and its back hunched before becoming immobilized, then you might have a gut shot. Check the stomach area for bloating, blood, and stomach fluid. If the bear was free-darted, there may be dark blood mixed with greenish stomach fluids or contents on the ground. If you find a wound or the stomach wall is rigid and you think the dart is in the bear, it is imperative that you get the animal to the nearest medical facility. A bear with a dart in its stomach can live for several days and can travel a great distance before peritonitis sets in.

Veterinarian Joseph W. Thompson removed a dart from the abdominal cavity of a black bear in 1988. The animal was monitored and eventually released back into the wild. If a bear is hit in the paunch with a dart in remote backcountry, Thompson recommends that you remove the dart. The sterile procedure described for implanting abdominal transmitters is recommended for this operation.

Clean your hands and arms to the shoulder with sterile

Figure 52. Photo of a grizzly skull that healed after a serious injury. The bear nearly had its nose ripped off by another bear.

solution or soap and water. Try gently removing the dart through the entry hole with a hemostat or forceps. If unsuccessful, make a mid-line incision just below the belly button and reach in with one hand and gently feel around for the dart. The bear should be on its back. Do not let any of the intestines squeeze out. If any intestines become contaminated, put them in a plastic bag and wash them with sterile solution and push them back into the abdomen. Reach around inside until you find the dart. If the dart is up around the femoral triangle, be careful not to damage the femoral artery. Also be careful not to puncture the intestines. This is especially true if the dart has a barbed needle. When the dart is retrieved, smell your arm to see if the intestine was perforated. If the needle is imbedded in an organ or is in the intestines, grab the end of it and wiggle it out slowly. If the animal is bleeding internally, try to stop the blood flow with finger pressure. If the femoral artery is pierced, wrap the site with stomach fat and attempt to match the pressure of the artery. If the dart injured an organ or pierced the intestines, cover the hole with internal fat. Suture the incision and dart wound carefully and radio collar the animal before releasing it.

If a dart enters a bear's lungs, the puncture wound will be just behind the shoulder area, and the blood will be frothy and cherry red. Remove the dart and cover the wound. If the lung is collapsed, the bear will probably die. Take the animal to a veterinarian if possible. If a bear is hit in the liver or kidneys, it will also probably die.

Documentation of the Death of a Bear

The documentation of a dead bear, especially if it is a grizzly in the lower 48 states, is important. If the animal died as a result of the trapping and handling episode, carefully document what happened. When possible, take photographs. Cool the carcass and contact state and federal authorities immediately. If this is not possible, skin the bear and collect urine and blood samples. Also take tissue samples from the muscle, fat, brain and every major organ (Table 5). Remove the reproductive tract of female bears and either freeze or place in formalin. If nothing else, collect a 1 x 1 inch piece of muscle, liver, and one eyeball. Store the samples in labeled plastic bags and freeze them as soon as possible. Avoid thawing. If the tissue is collected some time after death, estimate the time of death on the samples. The tissue samples may remain useful for 48 to 72 hours. Flesh the hide and cover it with at least an inch of salt.

If any parasites are observed in dead bears, portions of tissue containing them should be collected. To test for trichinosis, a portion of the diaphragm or tongue should be removed and placed in a plastic bag with several tablespoons of boric acid (LeCount 1986).

Table 5. Important tissue samples normally collected from a dead bear (50 grams of each, or 1 - 2 ounces).

Brain
Spleen
Liver
Heart
Lung
Urine (10 cc's)
Blood (serum)
Reproductive tract (collect the entire organ)
Tongue (check for trichinella)

Cub Caught With Female Present

This is one of the most dangerous situations possible when capturing bears. All safety precautions taken when selecting trap site locations and checking traps, for the most part, revolve around the possibility of having a bear standing guard over another bear. Whenever possible, at least two traps should be set at every trap site. This reduces the chance of approaching a trap and finding an angry mother grizzly standing guard over a trapped, bawling cub. Large sub-adult bears occasionally try to protect their sibling or mother, and mates have been known to protect each other. Bear handlers have several options when dealing with this kind of situation.

When you see another bear, or there is a possibility that other bears are at the trap site, you can either try to release the trapped bear or capture the others. Your decision will depend a great deal on the behavior of the free-ranging animal, the layout of the trap site, and the over-all goal of the trapping episode.

The best course of action, for example, when a cub is in a culvert trap and an angry mother is guarding it, is simply to release the cub. The predicament is thus taken care of quickly with less danger and stress. This option should only be attempted when a vehicle can be driven along side the trap and an armed passenger can step out, with no fear of an attack, and tie a rope to the door. In the backcountry, if the free-ranging bear leaves on approach, two armed individuals can tie a long rope to the door and release the animal from a safe distance.

When the trapped bear is in a snare and it cannot be approached safely by vehicle, it can be left in the trap until the free-ranging bear gives up and leaves the area. Females that have several cubs are more likely to leave one offspring in a trap after a day of waiting. Eventually, even protective mothers will leave the site for water or food. The cub can then be released and allowed to catch up with its mother. Make sure, however, that the trapped bear is in good health and not in danger of breaking loose with the snare during the night. The trapped bear should be monitored, and the entire area should be closed to human travel. Occasionally, the free-ranging bear can be darted from a distance. This should only be done, however, from the safety of a vehicle.

If the free-ranging bear leaves the general vicinity when the trappers approach, snares can be set on trails leading toward the trap site. For example, a snare can be positioned in such a way that when the mother returns to visit her cub, she will be captured. Make sure that the mother and cub will not get twisted up in each other's cable. Occasionally, a free-ranging bear will enter another culvert trap.

When a bear refuses to leave another trapped bear and the area can be approached by helicopter, the aggressive animal can be driven away by the chopper, and then two armed individuals can get out and quickly drug or release the bear in the trap.

When a trapped animal is unapproachable because of thick timber and the unknown location of an aggressive mother or mate,

two or more dogs can be brought to the site and used to divert the attention of the aggressive bear. Care must be taken to keep the dogs away from the trapped animal. An operation like this requires trained dogs, an experienced dog handler, a person to do the drugging and release operations, and one or two armed individuals for backup. The people involved should be familiar with their weapons, and most importantly, be able to function under severe stress.

Capturing and Relocating an Entire Family Group

Before relocating any female bear, make sure there are no offspring left at the site. The nipples of every captured female should be examined. Failure to observe milk or even swollen mammae does not necessarily mean the bear is not traveling with young. The surrounding area should be checked thoroughly for cub tracks and scats. When only one cub is present, always assume there are others.

When you have the mother in the trap and must catch her offspring, you have several choices. Quite often female bears will send their offspring away from the site. In many cases, especially with black bears, the young can be found in trees a short distance away. If the situation requires immediate action you can climb up the tree, but it is not recommended. (See section on drugging a bear in a tree). If there is time to wait and the female is in no danger, the crew members should hide and wait until the young come back to the mother.

When the female is in a culvert trap and the cubs are still known to be in the vicinity, she should be immobilized with a fairly heavy dose of Telazol and left in the trap and used as a lure for the cubs. The crew members, using several hundred feet of light rope, can conceal themselves and then manually close the culvert door when the cubs crawl into the trap with their mother. It is recommended that someone observe the cubs and the mother with binoculars to insure that they are completely in the trap when the door is closed. Culvert traps with two separate chambers are available.

If snares are available, a series of snares rigged to catch cubs can be set around the female. Occasionally, a cub will enter another culvert trap baited with food. These techniques also work when a trapped bear's mate needs to be captured as well.

If the terrain is fairly open and flat, cubs can sometimes be chased down and captured by hand with a lariat or a commercial pole-snare. When handling cubs, wear protective clothing and remember not to use too much force.

Immobilizing and Releasing Non-target Animals

When snares are used to capture bears, other wildlife species are occasionally captured. In order to release these animals, they

must be physically restrained or chemically immobilized. Non-target animals that must be drugged should be given a minimum dose. All you usually need to do is get the snare off the animal. Every drug kit should contain Telazol, commercial Ketamine, commercial Rompun, and concentrated 2:1 Ketamine/Rompun mix. These drugs can be used on dogs, wolves, coyotes, mountain lions, and a variety of ungulates.

Ketamine and Rompun is recommended for immobilizing mountain lions. The Montana Department of Fish, Wildlife, and Parks recommends a dosage of 2 ml/100 pounds of the concentrated 2:1 Ketamine/Rompun mix (300 mg/ml) for a total dose of 6 mg/pound. Lions can also be dosed with straight Ketamine. The suggested dose is 4 to 10 mg/pound (Hebert and McFetridge 1978). The suggested dosage rate of Telazol for mountain lions is 1 to 1.5 mg/pound (Schrobert 1987). The Telazol doses for other carnivores are: wolves (1-2.5 mg/pound), coyotes (5 mg/pound), and badgers and wolverines (2 mg/pound; Schrobert 1987).

A large bottle of Rompun should always be present to immobilize elk, moose, deer, bighorn sheep, and domestic cows (Bauditz 1972). Rompun is a sedative and analgesic sold commercially in 100 mg/ml concentrations. Dosages produce sedation which is usually maintained for one to two hours, and analgesia which lasts 15 to 30 minutes (Table 6). However, to remove animals from snares, a high level of sedation is usually not necessary.

Once the animal is drugged, it should be left alone for 25 to 30 minutes. It is recommended that animals drugged with Rompun not be approached before the full onset of anesthesia. Adverse reactions may occur if the subject is approached too soon. If the animal has been underdosed, wait for 30 to 60 minutes before administering a second dose. Administer Yohimbine when finished to reverse Rompun's effects. Observe the animal until it is able to stand. Keep the animal warm in colder weather.

Ungulates, especially moose, or prone to overheating when they are captured and handled. Be ready to cool the animal with water while frequently checking the body temperature with a rectal thermometer. If possible, a cold water enema is one of the best ways for cooling an animal (Johnson pers. comm.). Never roll an ungulate completely over. Try to keep them positioned on their sternum. Prop them up against a tree or log if necessary, and physically hold their head up if they are deeply sedated. Keep their eyes covered and protected from the sunlight. Apply a bland opthalmic ointment like you would for a bear.

Table 6. Recommended Rompun dosages for ungulates.

Mule deer--1.0 to 2.0 ml/100 lbs. body weight (1.0 to 2.0 mg/lb.)
White-tailed Deer--1.0 to 2.0 ml/100 lbs. body weight (1.0 to 2.0 mg/lb.)
Elk--0.25 to 0.5 ml/100 lbs. body weight (0.25 to 0.5 mg/lb.)
Moose--0.5 to 1.0 ml/100 lbs. body weight (0.5 to 1.0 mg/lb.)
Caribou--0.5 to 0.9 ml/100 lbs. body weight (0.5 to 0.9 mg/lb.)
Cattle Family--0.5 to 1.4 ml/100 lbs. body weight (0.5 to 1.4 mg/lb.)
Sheep Family--0.05 to 0.5 ml/100 lbs. body weight (0.05 to 0.5 mg/lb.)

Treating Human Exposure to Drugs

Wildlife biologists and managers need to take great care while handling drugs in the field. Some narcotics used in wildlife, such as Carfentanil and M99, are especially dangerous to humans. For example, one drop of M99 or Carfentanil on a person's skin can cause death. Therefore, it is recommended that neither of these drugs be used by bear researchers. The dissociative drugs (tiletamine, ketamine, and phencyclidine) are not as dangerous to humans, but still require immediate action in cases of accidental injection. All bear managers and researchers should be trained in emergency cardiac care and cardiopulmonary resuscitation (CPR).

Drug-related accidents occur in a variety of ways. One of the most common mishaps occurs when drug mist from a discharged dart is blown by the wind into the eyes and mouths of crew members. A dart, for example, loaded with M99 could strike a branch in its path and spray drug back toward the crew, or an internal charge for a Cap-Chur dart could be placed in backwards. When the trigger is pulled, the dart's internal charge would set off prematurely, and drug would spray out of the barrel showering the area.

M99 And Carfentanil

The treatment for M99 and Carfentanil is included to stress the reasons for not using them as a chemical restraint for bears in the field. M99 (etorphine) and Carfentanil are extremely dangerous drugs and should only be used in the presence of an Emergency Medical Technician. Most federal and state agencies have discontinued the use of these drugs because of danger to the handler and bear, and these drugs' high potential for street abuse. Treatment for M99 and Carfentanil poisoning requires immediate action. Any drugging kits with M99 or Carfentanil must include at least 90 vials of Narcon, the human antidote. The symptoms for exposure to M99 or Carfentanil include: 1) severe respiratory depression, 2) severe loss of blood pressure, 3) dizziness and disorientation, 4) loss of consciousness, 5) muscle rigidity that could prevent CPR, 6) vomiting, and 7) constricted pupils.

The patient will require immediate treatment. Place the victim on his back, maintain an open airway, and if necessary begin CPR. At the same time, four vials of Narcon must be injected into the patient's tongue or thigh through the clothing. Inject 20 to 30 additional vials of Narcon at one-minute intervals until the victim is alert. When the victim does become alert, inject twice the dose already given (40 to 60 vials). Administer more drug as needed, and get the patient to a hospital. If there is no Narcon in the drug kit, administer the equivalent dosage of the drug's antidote as an emergency treatment.

Sernylan, Ketamine/Rompun, and Telazol

Sernylan is the most dangerous of these cyclohexanone compounds. If a person is accidentally drugged with a full dosage, only 10 to 15 minutes are available to obtain medical assistance. It has no antidote, but recovery is possible with continual resuscitation or CPR. Ketamine/Rompun and Telazol are not as potent as Sernylan but do have the same symptoms. An equivalent dose of either of the phenothiazine drugs Acepromazine or Sparine will counteract the adverse actions of Sernylan, including the hallucinations, hypertonicity, hyperactivity, and salivation (Seal 1985). Every drug kit containing any of these dissociative drugs should also contain a six-pack of cranberry juice. Drink the juice immediately to acidify the body fluids and thus help counteract the drug's effects.

Symptoms of exposure/reaction to these drugs include: 1) hallucinations, 2) violence, 3) blank staring, 4) loss of voice, 5) rapid eye movement, 6) vomiting, 7) coma, 8) convulsions, and 9) high blood pressure. Even in small doses, Sernylan can be dangerous. The side effects in humans include extremely hostile behavior. Patients should be restrained by wrapping them in a blanket or rope.

APPENDIX II.

CHEMICAL RESTRAINT OF BEARS WITH A BLOWGUN AND DISPOSABLE SYRINGE DARTS

(written by H. Carriles and excerpted from M.S. Thesis)

Modern wildlife research and management techniques routinely rely on the capture and chemical restraint of wild animals. Remote injection should be accomplished with a minimum of stress and trauma to the animal, and an acceptable safety margin for field personnel. In the past, these requirements were met by CO_2 and powder charged weapons shooting an automatic, powder charged syringe (Fowler 1982). The resurrection of the ancient blowgun for the remote delivery of medication and immobilizing drugs, has proven equally effective in many field applications. Several commercially produced systems are now available (Nielsen 1982). Much recent progress has been reported, however, in the development of blowgun darts made from disposable plastic syringes (Brockelman and Kobayashi 1971, Dewey and Rudnick 1973, Bubenik and Bubenik 1976, Haigh 1976, Haigh and Hopf 1976, DeVos 1979, Warren et al. 1979, Barnard and Dobbs 1980, Lochmiller and Grant 1983). The various systems use springs, weights, compressed air, butane or sodium bicarbonate-acid reactions to effect drug injection upon impact. This paper describes the construction and use of a blowgun dart developed by Haigh and Hopf (1976) for the immobilization of bears. A few minor modifications to the original design have improved performance and reliability.

The blowgun was used under a wide variety of conditions. Black bears (*Ursus americanus*) and grizzly bears (*U. arctos*) were immobilized from 1981 through 1985 in five different areas. The initial use of the blowgun on snared bears occurred in the North Fork of the Flathead River drainage of northwestern Montana in 1981 and 1982. Snared bears were also drugged with the blowgun in October 1982 while the author was working in the Mission Mountains on the Flathead Indian Reservation. During 1984 and 1985 bears were drugged in the Cabinet Mountains of northwestern Montana. Caged and culvert-trapped bears were drugged at Fort Missoula, Montana from 1982 through 1983 during a repellent/deterrent study. Snared and culvert-trapped bears were drugged at Sparwood and Elkford, British Columbia.

METHODS

Blowpipe Construction

The blowpipe can be constructed from any suitable metal, plastic, or fiberglass tubing with a smooth interior wall, and of the appropriate inside diameter (ID). For 5 ml darts I use seamless aluminum electrical conduit that is available in 183 cm lengths (16.5 mm ID). For easy transport it is cut into 3 sections, each 61 cm long, with a tubing cutter. The lip created on the inside of the tubing at the cut must be filed and sanded smooth to eliminate obstructions to the dart as it is propelled through the pipe. Machined UHMW polyethylene sleeves, 7.6 cm long, join the sections to minimize air leakage at the joints. Seamless aluminum conduit is also available in suitable ID's for use with 1, 3 and 10 ml

darts. The various pipes nest within one another for easy transport if more than 1 size dart is needed in the field.

Dart Construction

The materials needed to construct a single 5 ml dart are listed in Table 5-1. The procedures for constructing 1, 3 and 10 ml darts are similar to those described below.

Table 5-1: Materials necessary to construct a single 5 ml dart.

DART
1 sterile 5 ml plastic disposable syringe (Luer-lok).
1 5 ml syringe (need not be sterile).
2 21 gauge hypodermic needles.
5-6 strands of colored acrylic knitting yarn (approx. 6 cm long).
glycerine
NEEDLE
1 16 gauge hypodermic needle (3.7 cm long).
Tygon microbore tubing (5-6 mm long)
Epoxy glue.
Super glue.
CHARGING UNIT
Butane gas canister with red adapter.
1 21 gauge hypodermic needle.
Epoxy glue.

Withdraw the handle of a sterile syringe until only the front of the rubber plunger remains in the barrel. Cut the handle off directly behind the plunger with a sharp knife (Fig. 5-1a) and apply a few drops of glycerine to the plunger (Bubenik and Bubenik 1976) before reinserting it fully into the syringe. Now, cut the finger flange off of the syringe barrel with a knife (Fig. 5-1b) as close to the flange as

possible to avoid excessive shortening of the barrel. A second plunger with the handle removed is used for the tailpiece. Insert 5 to 6 doubled strands of brightly colored acrylic knitting yarn into the rear of the plunger with a pencil and trim the ends (Fig. 5-1c). Take 5 to 6 turns around your index and middle fingers to get the proper length of yarn. Coat the outside surface of the tailpiece with epoxy glue and insert it into the rear of the syringe. Insert a 21 guage needle through the syringe wall into the plunger and out the opposite wall (Fig. 5-1d). A second needle is inserted perpendicular to the first (Fig. 5-1e). Cut the protruding ends of the needles off and file flush with the barrel of the dart.

Prepare a 16 guage needle (Fig. 5-2a) by drilling 2 lateral holes in the shaft, 2 mm apart, the first approximately 7 mm from the tip (Fig. 5-2b). A Dremel Tool (Dremel Mfg. Div., Emerson Electric Co., Racine, Wisconsin) mounted on a drill press with a No. 110 grinding bit is used to drill the holes. A single bit will drill approximately 20 holes (10 needles). A No. 2 carbide bur dental bit will also work. Seal the end of the needle with epoxy and place a drop of Super glue (Loctite Corp., Cleveland, Ohio) over the dried epoxy to plug any pinhole leaks that may persist (Fig. 5-2b). Slip a 5 to 6 mm length of Tygon tubing (Norion Plastics and Synthetics Division, Akron, Ohio) over the holes to seal the needle for use (Fig. 5-2c).

Charging and use of the dart

The dart is charged with butane from commercially available canisters that are used primarily to refill cigarette lighters. Attach a 21 guage needle to the red adapter supplied with the butane dispenser by trimming the end (Fig. 5-3a) so that the needle fits over it. Coat the adapter with epoxy and attach the needle (Fig. 5-3b).

Using a large capacity syringe ($\geq$10 ml) adjust the movable plunger to the desired drug volume by increasing or decreasing air pressure within the charging chamber. Holding the dart upright, load the drugs with a sterile syringe, through the needle attachment flange (Fig. 5-4a). Attach a prepared needle. Invert the dart (needle down) and insert the charging needle through the tailpiece. Charge the dart by pushing back on the valve to inject liquid butane into the charging chamber (Fig. 5-4b) and quickly pull the needle out of the tailpiece. A drop or two of liquid butane will be visible between the plunger and the tailpiece. Figure 5-4c illustrates a charged dart ready for use.

Upon impact, the Tygon sleeve is pushed back by the animals hide exposing the holes in the needle. The release of pressure allows the butane to expand, pushing the movable plunger forward. Drug injection occurs within 1 to 2 seconds of impact, depending on the volume and viscosity of the particular drug being used.

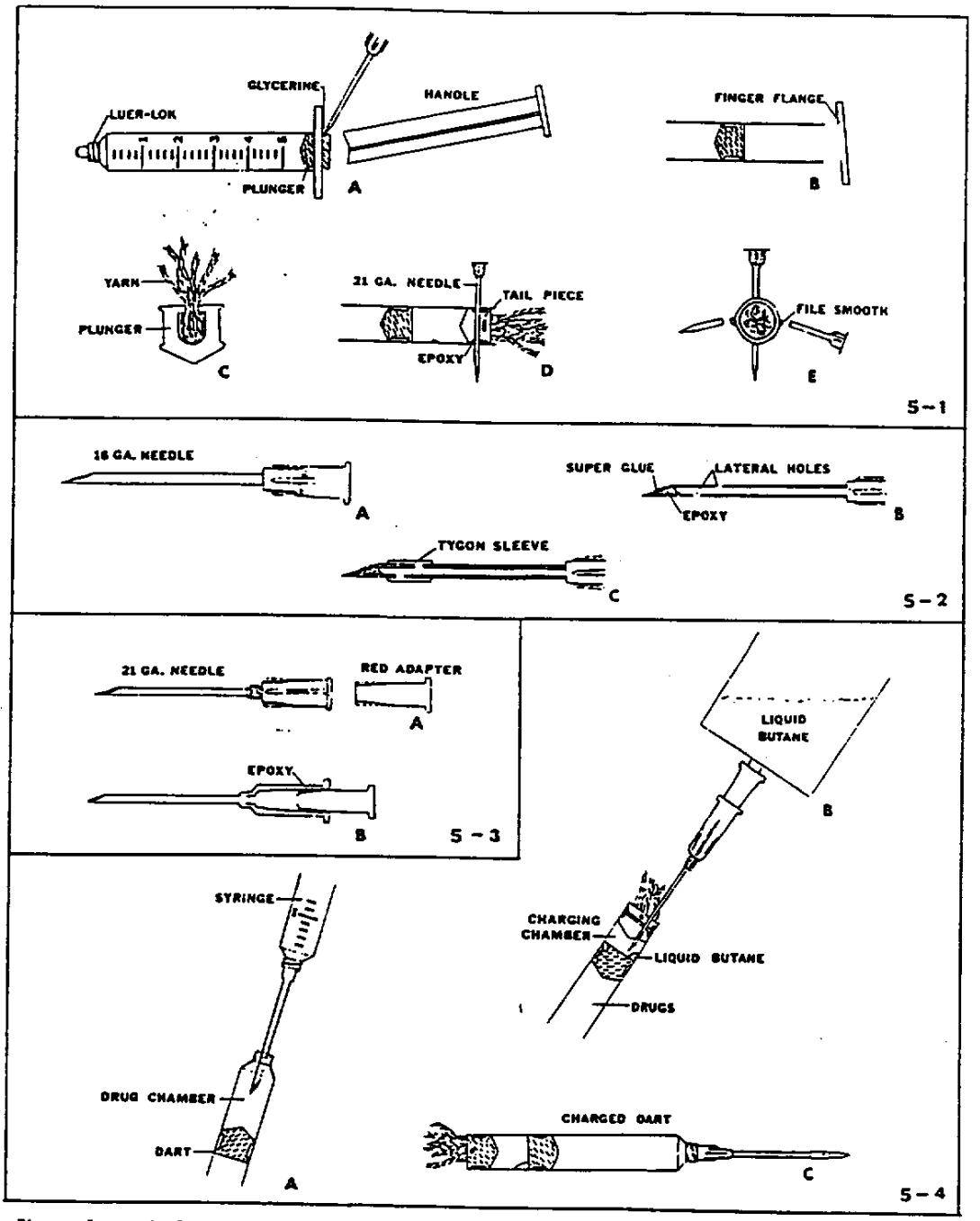


Figure 5— 1. Dart construction. 2. Needle preparation. 3. Preparation of charging needle. 4. Loading and charging the dart.

Immobilization procedures

Bears were immobilized after capture in Aldrich leg-hold snares, culvert traps, or while being held captive in the University of Montana holding facilities at Fort Missoula. Three black bears were drugged free-ranging. A variety of drugs were used, including mixtures of ketamine hydrochloride-xylazine hydrochloride (Ketaset-Rompun), phencyclidine hydrochloride-promazine hydrochloride (Sernylan-Sparine) and tiletamine hydrochloride-zolazepam hydrochloride (Telazol). The drugs were delivered by blowpipe using 3, 5 and 10 ml plastic disposable syringe darts. Darts were fired at distances ranging from <1 m to approximately 10 m. The majority of bears were shot in the neck and shoulder region allowing rapid drug absorption and faster immobilization than the hind quarter area.

RESULTS

Ninety five black bears and 16 grizzlies were successfully immobilized with the blowgun and plastic disposable syringe darts. A grizzly with three cubs was missed twice. She became overly aggressive and a Palmer "Cap-chur" (Palmer Chemical and Equipment Co., Douglasville, Georgia) gun was subsequently used for added safety. The first blowdart flew erratically and the second one hit her old collar and dropped to the ground without injecting the drug.

A total of 177 darts were shot at bears, five (2.8%) of which completely missed the animal. Twenty five (14.3%) of the darts that did hit bears did not inject the drug for various reasons which will be discussed later.

DISCUSSION

The use of the blowgun and plastic disposable syringe darts for the immobilization of bears has certain advantages over other types of equipment. The pole-mounted syringe (jab stick) and the Palmer Cap-chur gun are the most common drugging equipment used on bears in North America today. The blowguns main advantage over the jab stick is that it is effective up to 15 m, depending on the size of the dart and the proficiency of the operator. The jab stick must be used at close range, leaving a minimal safety margin for the operator if a bear should break loose (Hofstra 1982).

Although the blowgun does not have the range capabilities of the commercial powder charged systems it has several advantages over those systems. The blowgun is accurate, easy to use, lightweight, and portable, and it requires little maintenance. It is inexpensive and easy to construct; a single 5 ml dart costs approximately 50 cents to make and it can be reused a number of times. The blowgun is quiet, the dart causes little trauma at the injection site, and the clear plastic body of the dart allows confimation that the drug has injected while the dart is still in the bear. The barbless needle allows the dart to passively drop from the animal's hide, avoiding further injury or the need to cut the hide to remove the needle.

The operator can become acceptably accurate with the blowgun in a day by practicing with water-filled darts. Practice should include the various size darts over the full range of distances that they can be effectively shot. Aiming is instinctive and improves with practice, however, the amount of air used to propel

the dart should be consistent with every shot. A short, hard blast of air should be expelled without any head or arm movement. Any movement of the upper body will move the end of the pipe, throwing the dart off target. Darts should be shot perpendicular to the intended impact area to insure penetration of the hide.

Most bears captured in snares can be safely drugged with a blowgun. It is well suited to the immobilization of all but the most aggressive bears, or those not caught firmly by the wrist (e.g., caught by the toes). In such situations the powder charged equipment gives the operator a greater safety margin. Jab sticks should not be used on snared animals because of the high risk to the operator. Hofstra (1982) described an incident in which an escaping bear injured a biologist who was attempting to drug it with a jab stick. Caged, culvert-trapped and denned bears are easily drugged with the blowgun and it should be the method of choice in these situations.

All missed shots, except one that flew erratically, were caused by movement of the animal when the dart was fired. Most darts were recovered fully charged and reused after replacing the needle with a sterile one.

Malfunctioning darts included those that hit the target but did not inject the drug, and those that broke on impact. Darts that did not inject on impact were either not fired with enough velocity to penetrate the hide, or they hit the hide at such an angle that they glanced off. Shots should be taken as close to perpendicular to the hide as possible, to avoid glancing darts. The use of a single section of pipe (61 cm) can also result in some darts failing to penetrate the hide. The dart does not gain enough velocity before it leaves the end of the pipe. In

one instance, two darts fired at a captive black bear penetrated the hide but the drug did not inject. Several minutes later the moveable plunger of one of the darts was observed as it injected the drug into the bear. The plunger took almost a minute to travel the length of the dart. This dart had been used several times before and malfunctioned during the winter when temperatures were near 0°C. Later, at room temperature, the dart functioned properly, but the plunger moved slower than normal. This problem has not occurred since I began coating the plunger with glycerine (Bubenik and Bubenik 1976) during construction of the dart.

Darts usually break when they hit large bones. The force of impact breaks the dart at the needle attachment (Luer-lok). Darts that have been reused a number of times may weaken at this point and break with normal use. Fletcher (1980) described a method for reinforcing the needle attachment flange. Cut the tip off of a 3 ml syringe (without Luer-lok). Then cut the syringe at the 1.1 ml mark with a razor blade. Slide the needle of the dart through the center hole and fit the barrel of the cut 3ml syringe snuggly over the Luer-lok of the dart. This method distributes the force of impact over the barrel of the dart and away from the needle attachment. The modification increases dart life by preventing the needle attachment from weakening excessively during normal use. Large darts, particularly the 10 ml size, tend to weaken at this point due to the weight of the increased volume of drug.

The blowgun is almost silent and hits with minor impact, which reduces stress and virtually eliminates trauma to the animal being drugged. The depth to which the needle penetrates the hide can be regulated by varying the length of the

Tygon sleeve (Haigh and Hopf 1976). Shots that would normally be injurious or fatal to an animal when using powder charged equipment cause little concern when using a blowgun. Two snare-captured bears that were accidentally shot in the ribs with the blowgun barely reacted to the plastic dart; immobilization occurred without complications. Increased aggression induced by excessive noise, movement, and pain during injection causes increased drug induction time and decreases the safety margin for the operator and the bear. The blowgun virtually eliminated these problems in the majority of immobilization attempts in which it was used.

APPENDIX III.

SAMPLES OF CAPTURE FORMS TO USE WHEN HANDLING BEARS

A. Yellowstone Interagency Grizzly Bear Study Team
B. Cabinet-Yaak Bear Study

GRIZZLY BEAR TAGGING FORM

Res. or Mngt ?

method trapped: bait used: Bear No._____

Date: Location: UTM:

Trappers: Agency:

Immobiization Procedures

strength of drug used (mg/cc): dosage (mg/lb):

TIME	DRUG	DOSAGE (cc)	INJECTION SITE	METHOD	REACTIONS

(continue procedures on back)

Time bear immobile: Time recovery started: Time recovery complete:

Measurements (in cm):

A. Total Length _____

A-1. Contour Length _____

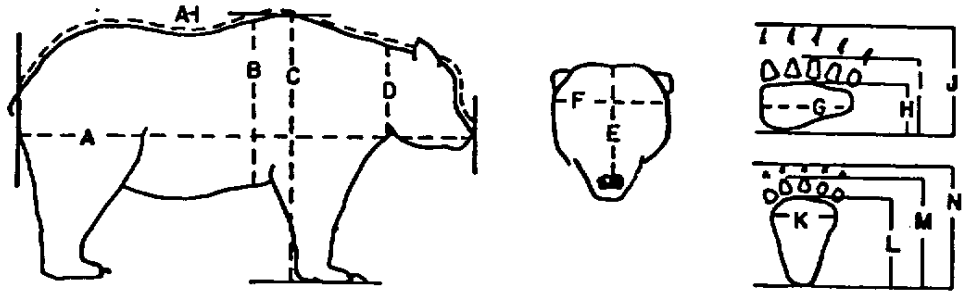
B. Girth _____

C. Height _____

D. Neck Circ. _____

E. Head Length _____

F. Head Width _____



Measurements (in mm):

G _____ I _____ K _____ M _____

H _____ J _____ L _____ N _____

SAMPLES TAKEN:

Tooth_____ Blood_____

Hair_____ Tissue_____

Physiological monitoring:

TIME	RESPIRATION	HEART BEAT	TEMP

Weight: est._____ scale_____ Sex:_____ Est. Age:_____

Old markers present:_____

Tattoo:_____ (where) _____

Ear Tags: Rt_____ (color)_____ Lft_____ (color)_____

Radio collar:

Reproductive status:_____

Frequency:_____ Transmitter No.:_____ Color:_____

Collar attached with:_____

Transmitter working? yes no Magnet removed? yes no

Body description & condition:

Remarks:

IGBST 05/91

GRIZZLY BEAR DRUGGING DATA

From #:

STUDY	STUDY AREA	[_]
(1) YEL (2) NFF (3) SFF (4) EF (5) SEL (6) NC		
ID	BEAR ID	[___]
JUL	JULIAN DATE	[___]
YR	YEAR	19[__]
TM	MILITARY TIME (Missing = 9999)	[____]
SEX	SEX (1) Female (2) Male	[_]
AGE	AGE (Missing = 99)	[__]
CLASS	AGE CLASS	[_]
(1) Cub (2) Yearling (3) Subadult (4) Adult (5) Female w/young		
WGTM	WEIGHING METHOD (1) Scale (2) Estimate	[_]
PDS	BEAR WEIGHT (POUNDS)	[___]
DRUG	DRUG	[_]
(1) Ketaset/Rompun (2) Sernylan (3) Telazol (4) M99		
CONCA	ANESTHESIA CONCENTRATION (mg/cc).	[___]
CONCT	TRANQUILIZER CONCENTRATION (mg/cc, N/A = 999).	[___]
INJM	INJECTION METHOD	[_]
(1) Cap-Rifle (2) CO2 Pistol (3) Air R or P (4) Blowgun (5) Jab		
INJS	INITIAL INJECTION SITE	[_]
(1) Rump (2) Shoulder (3) Low hindleg (4) Low foreleg (5) Neck		
VOLI	INITIAL VOLUME (CC)	[__.__]
SDN	N SUPPLEMENTAL INJECTIONS	[_]
VOLS	SUPPLEMENTAL VOLUME (CC)	[__.__]
IMMOB	IMMOBILITY TIME (MIN)	[__]
VOLB	BOOSTER VOLUME (CC)	[__.__]
ANTA	ANTAGONIST (1) Yes (2) No	[_]
HANDTM	MINUTES TO ANTAGONIST (N/A = 999)	[___]
ANTM	ANTA INJECTION METHOD	[_]
(1) Intramuscular (2) Intravenous (9) N/A		
ANTS	ANTAGONIST INJECTION SITE	[_]
(1) Rump (2) Shoulder (3) Low hindleg (4) Low foreleg (5) Neck (6) Tongue (9) N/A		
VOLA	ANTAGONIST VOLUME (CC)	[__.__]
RECOV1	MIN TO HEAD UP	[___]
RECOV2	MIN TO WALKING	[___]

BLACK GRIZZLY BEAR CAPTURE FORM

* SHALL BE RECORDED AT EVERY CAPTURE

DATE_____ TIME_____ PERSONNEL_____

DRAINAGE_____ UTM_____

SEX_____ AGE: EST_____ ACTUAL_____ OTHER BEARS_____

WEIGHT: EST_____ ACTUAL_____ TIME YOU LEFT AREA_____

MARKINGS: L R

TAG NUMBER_____/_____ COLOR_____

STREAMER STATUS_____

TATOO NUMBER_____ COLOR_____

RADIO FREQUENCY_____ SPACER_____

*TRAP WOUNDS_____

_____

*FOOT CAUGHT: RF LF RR LR

*OTHER WOUNDS_____

_____

TOOTH TAKEN_____

BLOOD SAMPLES_____

OTHER SAMPLES_____

PARASITES_____

REMARKS_____

_____

_____

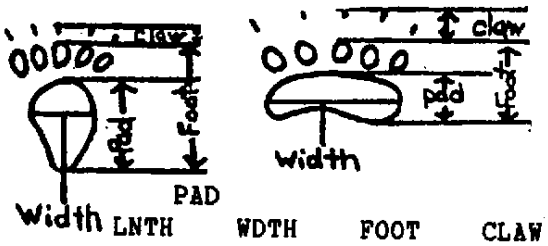
_____

_____

SPECIAL MARKINGS_____

_____

MEASUREMENTS:



	LNTH	WDTH	FOOT	CLAW
FRONT				
REAR				

HEAD CIRCUMFERENCE_____

NECK SIZE_____

*CHEST GIRTH_____

*ZOOLOGICAL LENGTH_____

SHANK LENGTH_____

SHOULDER HEIGHT_____

BACULUM LENGTH_____

TESTES: LNTH_____ WIDTH_____

*NIPPLE (mm): LNTH_____ WDTH_____

NIPPLE COLOR: PINK DARK

*LACTATION: YES NO

*ESTROUS: YES NO

*FAT LEVEL (1-5):_____

HAIR COLOR: BLACK BROWN

DRUGGING INFORMATION

SPECIES: BLACK GRIZZLY BEAR NUMBER_____

STUDY AREA_____ DRAINAGE_____

DATE_____ TIME_____ SEX_____ AGE_____

AGE CLASS: CUB YEARLING SUBADULT ADULT ADULT FEMALE WITH YOUNG

WEIGHT: ESTIMATE_____ SCALE_____ REGRESSION_____

	DOSE 1	DOSE 2	DOSE 3	DOSE 4	DOSE 5
DRUG					
ANESTHESIA CONC.					
TRANQUILIZER CONC.					
INJECTION METHOD					
INJECTION SITE					
VOLUME OF DRUG					
INJECTION TIME					

MINUTES TO IMMOBILITY _____

ANTAGONIST_____ VOLUME_____ TIME OF INJECTION_____

MINUTES SINCE INITIAL INJECTION_____ INJECTION SITE_____

INJECTION METHOD: INTRAMUSCULAR INTRAVENOUS

MINUTES TO HEAD UP_____ MINUTES TO WALKING_____

TIME YOU LEFT AREA_____

APPENDIX IV.

RECOMMENDED DOSAGE CHARTS FOR GRIZZLY AND BLACK BEARS

A. CALCULATING DOSAGES

The Animal Restraint Handbook published by the California Department of Fish and Game (Jessup et al. 1986) provides a procedure for the calculation of drug dosages.

Information you must have to calculate the volume of drug for injection:

1. Weight of animal.

2. Concentration of the drug (mg/ml).

3. Recommended dose rate for that animal. This depends on the situation, the individual, and the time of the year.

Milligrams needed equals the recommended dose rate (mg/lb) times the animal's weight (pounds). After the mg needed is calculated, then determine the volume (ml) needed: Milliliters needed equals the mg needed divided by the drug concentration.

$$(\text{mg/ml}) = \frac{\text{ml}}{\text{mg}} \times \text{mg needed}$$

If the recommended dosage happens to be in mg/kg instead of mg/lb, a conversion is necessary.

1 kilogram = 2.2 pounds, or roughly (1/2) x mg/kg = mg/lb

B. TELAZOL DOSAGES FOR BLACK AND GRIZZLY BEARS

1 cc per 100 pounds*

2.5 mg per pound for black bears
(Dilute 1 vial with 2.0 cc of sterile water.)

4.0 mg per pound for grizzly bears
(Dilute 1 vial with 1.25 cc of sterile water.)

Weight (pounds)	Volume (cc)
50	.5
100	1.0
150	1.5
200	2.0
250	2.5
300	3.0
350	3.5
400	4.0
450	4.5
500	5.0
550	5.5
600	6.0
650	6.5

* Large bears may require 3 to 6 vials of Telazol.

Be sure to label the concentration and date on any partial vials (discard after 2 weeks). Be aware that the liquid extracted from a bottle of Telazol will be slightly greater than the volume of water added. The higher the concentration, the greater this difference.

GRIZZLY BEAR TELAZOL DRUG DOSAGES
3.6 mg per pound

100 mg/cc - dilute one vial with 5 cc water
200 mg/cc - dilute one vial with 2.5 cc water
300 mg/cc - dilute one vial with 1.7 cc water

WEIGHT (lb)	100 mg/cc VOLUME (cc)	200 mg/cc VOLUME (cc)	300 mg/cc VOLUME (cc)
25	.9	.5	.3
50	1.8	.9	.6
75	2.7	1.4	.9
100	3.6	1.8	1.2
125	4.5	2.3	1.5
150	5.4	2.7	1.8
175	6.3	3.2	2.1
200	7.2	3.6	2.4
225	8.1	4.1	2.7
250	9.0	4.5	3.0
275	9.9	5.0	3.3
300	10.8	5.4	3.6
325	11.7	5.9	3.9
350	12.6	6.3	4.2
375	13.5	6.8	4.5
400	14.4	7.2	4.8
425	15.3	7.7	5.1
450	16.2	8.1	5.4
475	17.1	8.6	5.7
500	18.0	9.0	6.0
525	18.9	9.5	6.3
550	19.8	9.9	6.6
575	20.7	10.4	6.9
600	21.6	10.8	7.2

C. KETAMINE/ROMPUN DOSAGES FOR BLACK BEARS AND GRIZZLIES

2:1 Ratio

300 mg per 100 pounds for black bears

540 mg per 100 pounds for grizzly bears

*Commercial Ketamine and Rompun is available in individual bottles at 100 mg/ml. Concentrated Ketamine/Rompun is pre-mixed at 300 mg/ml.

	Volumes (cc's)			
	Black Bears		Grizzly Bears	
Weight	Ket./Rom. (100 mg/ml)	Concentrate (300 mg/ml)	Ket./Rom. (100 mg/ml)	Concentrate (300 mg/ml)
50	1.0/.50	.5	1.8/.9	.9
100	2.0/1.0	1.0	3.6/1.8	1.8
150	3.0/1.5	1.5	5.4/2.7	2.7
200	4.0/2.0	2.0	7.2/3.6	3.6
250	5.0/2.5	2.5	9.0/4.5	4.5
300	6.0/3.0	3.0	10.8/5.4	5.4
350	7.0/3.5	3.5	12.6/6.3	6.3
400	8.0/4.0	4.0	14.4/7.2	7.2
450	9.0/4.5	4.5	16.2/8.1	8.1
500	10.0/5.0	5.0	18.0/9.0	9.0
550	11.0/5.5	5.5	19.8/9.9	9.9
600	12.0/6.0	6.0	21.6/10.8	10.8

D. RECOMMENDED YOHIMBINE DOSAGE FOR BEARS DRUGGED WITH KETAMINE/ROMPUN

.05 mg of Yohimbine per 1 mg of Rompun

(Yohimbine is sold in 5 mg/ml concentrations)

1 cc per 100 pounds for black bears
1.8 cc per 100 pounds for grizzlies

	Yohimbine Volume (cc)	
Weight	Black Bears	Grizzly Bears
50	0.5	0.9
100	1.0	1.8
150	1.5	2.7
200	2.0	3.6
250	2.5	4.5
300	3.0	5.4
350	3.5	6.3
400	4.0	7.2
450	4.5	8.1
500	5.0	9.0
550	5.5	9.9
600	6.0	10.8

APPENDIX V.

SUGGESTED CHECK LISTS FOR VARIOUS TRAPPING, DRUGGING, AND HANDLING KITS

A. Trapping Kit Check List:

General Trapping Supplies:

- Shovel and Pulaski
- Hatchet, Axe, and Chainsaw or Bow Saw
- Warning Signs
- Tape
- Old Collar Transmitter
- Rubber or Leather Gloves
- Binoculars
- Bait Barrel
- Bait and Scents
- Meat Hook
- Machete
- Garbage Bags
- Burlap Bags
- Rope
- Baling Wire
- Surveyor's Flagging
- 5 Gallons of Water

Culvert Trapping Supplies:

- Culvert Traps (fully rigged)
- 100 Feet of 1/4 Inch Rope (for opening door)
- Parachute Cord
- Vice Grips
- WD-40

Snare Trapping Supplies:

- Aldrich Foot Snares and Springs
- Extra 1/4 Inch Cable
- Cable Cutters or Cutting Torch
- Nycopress Tool
- Extra Nycopress Sleeves
- Extra 1/4 Inch Cable Clamps
- Extra Swivels
- Extra Angle Irons
- Socket Wrench
- Paraffin Wax

B. Drugging Kit Check List:

General Supplies:

- Drug Bag or Large Plastic Tackle Box
- Chemical Restraints and Tranquilizers:
  - Telazol (1:1 dry mix)
  - Ketamine/Rompun (2:1 dry mix)
  - Commercial Acepromazine or Sparine
  - Commercial Rompun
  - Commercial Ketamine
- Antagonists:
  - Yohimbine (Antaganol)
  - Dopram
- Sterile Isotonic Water
- Antibiotics:
  - LA-200 or Dual-Pen
- Diuretics:
  - Lasix
- Syringes and Needles (Luer Lock or Standard Style):
  - 3 ml and 10 ml syringes
  - 1 1/2 and 2 1/2 inch 16, 18 and 20 Gauge Needles
- Protective Latex Rubber Gloves
- Hard Sided Container (for drugging garbage)
- Electrician's Tape
- Cranberry Juice (for accidental injections)

Darting Supplies:

- Cold Sterile Wash, Water and Tupper Ware Container
- Cap-Chur Dart Assembly:
  - Cylinders (1 cc through 10 cc [four each])
  - Needles (Barbed, Collared, and Smooth in various lengths)
  - Rubber Plungers
  - Internal Charges (1-3 and 4-10 cc)
  - Tail Pieces (Cloth and Plastic)
- Blow Dart Assembly:
  - Plastic Blow Darts
  - Blow Dart Needles and Hole Plugs
  - Butane
- Sterile Jell
- Positioning Rods (2)
- Tissue
- Paper Clip (for cleaning dart needles)
- Wet Stone (for sharpening needles)
- Palmer Rifle and Case:
  - Extra .22 Adapter and O-rings
  - Powder Charges (green and brown)
  - String Tracker
  - Dart Transmitter
- CO2 Pistol/Rifle and Case:

Extra CO2 Cartridges
Extra Seal for Gas Chamber
Practice Dart
Cleaning Rod and Solvent
Cleaning Patches
Brass Brush
Cap-Chur Jab Stick
Blow Gun

Drugging and Handling Folder:

Metal Clipboard
Trap Forms (Waterproof Paper)
Pencils
Drug Dosage Charts
Bear Drugging and Handling Reference Manual
Extra Closure Signs
Bear Fact Sheet
Aging Chart
Weight Estimation Chart

C. Handling Kit Check List

Preparation Items:

Safety Snare
Bandanna or Gauze (to cover the bear's eyes)
Lacri-Lube Eye Ointment (a sterile eye lubricant)
Scissors (to trim away hair)
Furazol Spray (to treat wounds)
Envelopes (for hair and tooth samples)
Digital Thermometer
Stethoscope
Watch
Tape Measure
Extra 1/2 Inch Socket and Wrench (to release bears from tangled snares)
Camera (Fuji throw away)
Small Flash Light (and extra batteries)
Space Blanket
Ensolite Pad
Flagging (for marking sites, and wind direction marker for helicopter)
Smoke Signal (to show helicopter your exact site)
Extra Pencils

Weighing Items:

Hog Weight Tape
Conversion Chart for Bears
500 lb. Scale

100 lb. scale
Rope
Block-and-tackle
Weighing Cuffs or Tarp

First Aid Items:

First-aid Kit (for people)
Small Butane Torch (for cauterizing major wounds)
Endotracheal Tube (in case bear stops breathing)
Tourniquet (to control severe bleeding)
Needle and suture and needle holder (for suturing wounds)
Wire Saw (for amputation)
Large Syringe (for flushing wounds)
Electrician's Tape
Antiseptic Towel Wraps
Betadine (diluted)
Nolvasan or Instracal (diluted)
Antibiotics (LA 200)
Furazol Powder
Surgical Gloves
Sterile Cotton

Ear Tagging Items:

Ear Tag Pliers
Ear Tags (need a variety of different colors)
Ear Streamers
Ear Tag List (used to cross reference ear tag numbers)
Leather Punch

Tissue Sampling Items:

Scalpel Holder and Blades
Tissue Biopsy Needle
Hemostat
Container or Plastic Bag (for tissue sample)
Instant Ice Compress

Blood Drawing Items:

Vacutainers (red, yellow, and green or purple tops)
Vacutainer Holder
Vacutainer Needles
10 cc Syringe and 20 Gauge Needles
Instant Ice Compresses
Labels
Pipet
Serum Containers
Ethylene Glycol

Tooth Extraction Items:

Tooth Envelopes
Lifter
Tooth Pliers
Sterile Cotton

Tattoo Supplies:

Tattoo Pliers
Tattoo Digits (have a variety of numbers and letters)
Tattoo Ink
Stiff Tooth Brush
Rubber Gloves
Needle
List of Existing Tattoo Numbers

Collaring Supplies:

Appropriate Radio Transmitters
Receiver (to test collar frequency, beats per minute and reception)
Paddle or H-Antenna
Small Vice Grip
Nut Driver (to tighten collar nuts)
File (to remove sharp edges on collar bolts)
Small Bolt Cutter (to remove excess stem on collar bolts)
Rivet Gun, Rivets and Washers (to repair and rebuild collars)
Knife or Scissors (to cut off extra strapping)
Extra Collar Strapping (for repairs and for extra spacing under collar)
Collar Splices (canvas and elastic)
Collar Bolts, Brackets and Nuts
Epoxy
Electrician's Tape

D. Materials Needed for Abdominal Implants

General Supplies:

Abdominal Implant
Atropine (controls excessive salivation)
Nolvasan (cold sterilant)
Betadine Solution (antiseptic wash)
Sterile 4X4" Gauze Pads (for scrubbing)
Scissors
Razor and Shaving Cream or Clippers
Sterile Field Drape
Surgical Mask and Hairnet
4-5 Towel Clamps
Scalpel Handle and Blades (#3 or #4)

2-3 Hemostats
Thumb Forceps
Needle Holders
Sterile Gloves (Sizes 7 1/2 to 9)
Sterile Sponges
Suture (both absorbable and non-absorbable, size 0, 1, or 2)
Tapered Suturing Needles
Several Plastic Washtubs

APPENDIX VI.

HELICOPTER SAFETY

(Excerpted from Jessup et al. 1986)

Safety In and Around Helicopters

Helicopters are used for various reasons by wildlife workers; this subject is covered in Chemical Immobilization of North American Wildlife, Jessup DA: The Use of the Helicopter in Capture of Free-Roaming Wildlife, Milwaukee, Wisconsin Humane Society, 1982. These expensive, agile, powerful machines must be treated with respect. People have been injured, some fatally, in helicopter accidents that would not have occurred had they been briefed on helicopter safety.

Boarding

1. Establish a helipad that is off limits to everyone except authorized personnel.

2. Do not approach a helicopter unless the pilot or person responsible for loading can see you and has given you a sign to approach. Always come from the front or the side of the ship.

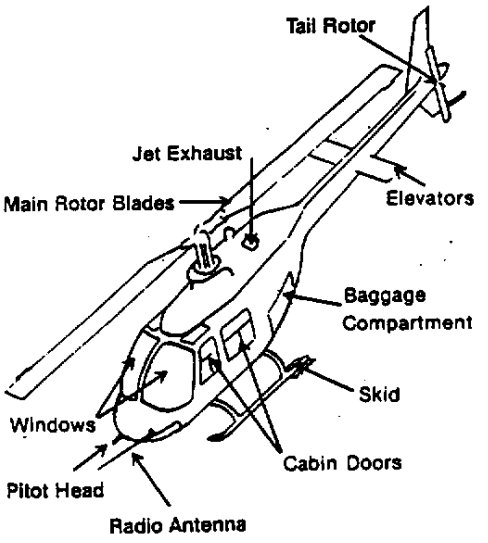
3. Always stay away from the rear of the helicopter.

4. Crouch low before walking under the main rotor, particularly if the ship is idling down or revving up (the blades dip lower then).

5. Hold firmly to hats and loose articles.

6. Never reach up or chase after a hat or other objects that might have blown away.

7. If suddenly blinded by dust or a blowing object, STOP -- CROUCH DOWN UNTIL YOU CAN SEE. NEVER GROPE OR FEEL YOUR WAY TOWARD OR AWAY FROM THE HELICOPTER.

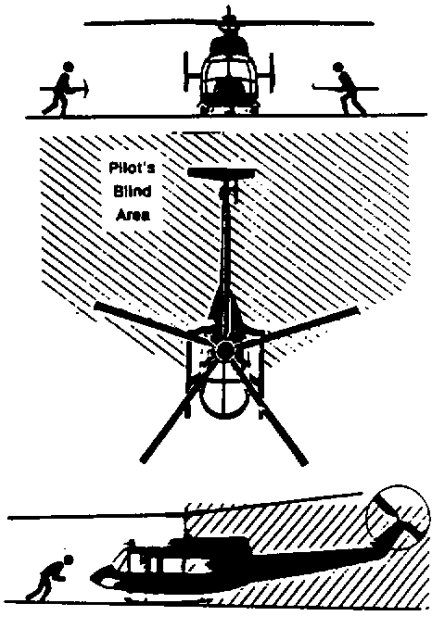


ROTORS CAN KILL

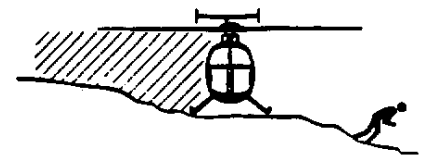
Loading and Unloading

Cargo should be loaded carefully and not thrown, dropped, or jammed in the cabin. Load and secure as the pilot instructs. Do not smoke in or around helicopter. If sitting by an open door, secure all loose equipment, wear safety belts at all times. If leaning out to dart, wear extra safety harness. Upon deplaning, be sure seat belts are not left hanging out; if the rear doors have been removed, as is often the case in animal work, reconnect the seat belts and tuck them in the seat cushions. Unload next to the helicopter. Never throw anything away from the helicopter. Never carry anything over your head when near the helicopter. Loaded firearms are not allowed on board the helicopter. Weight down light equipment and loose articles, then leave landing area before the helicopter takes off.

The helicopter is normally very safe but must be approached with caution. Those areas which present a hazard should be avoided at all times.



Approach and leave the helicopter in a crouched position and always within view of the pilot. Never towards the rear of the helicopter.



On uneven ground always approach and leave on the downhill side. Never on the uphill side.